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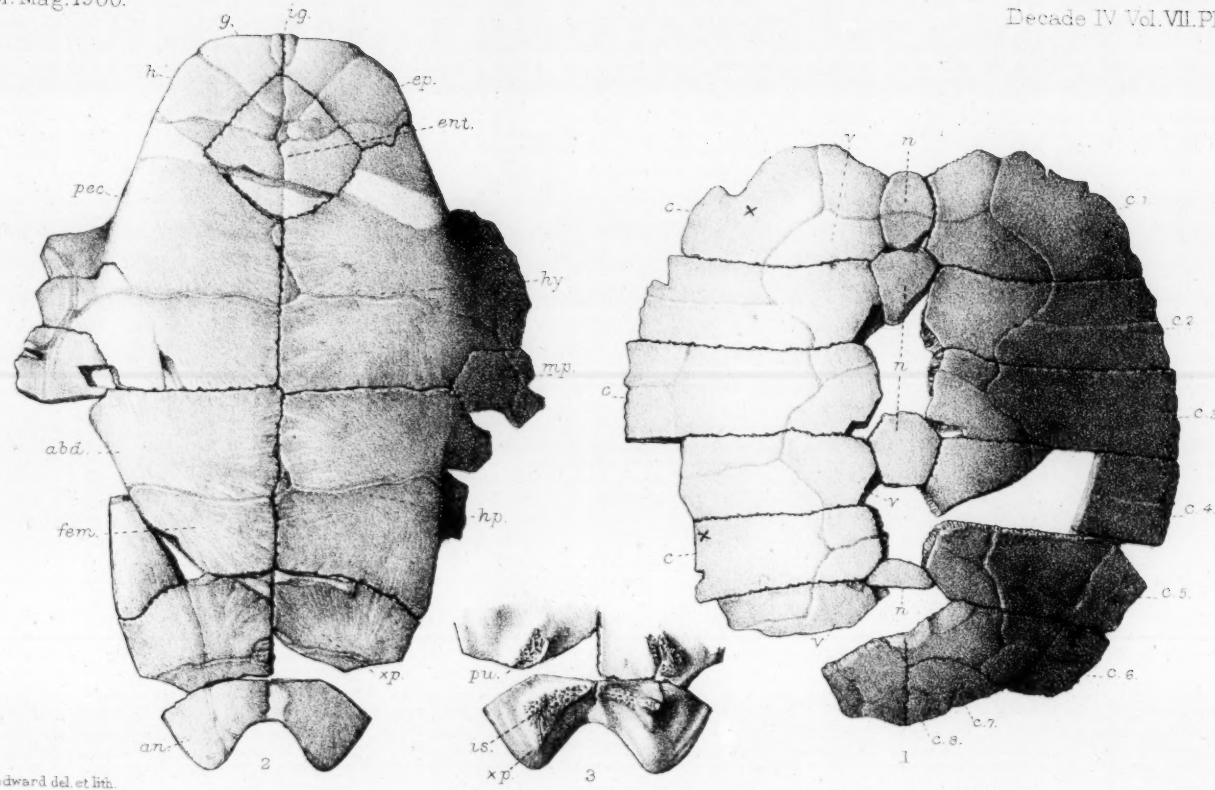


G.M. Woodward del. et lith.

Podocnemis ægyptiaca *sp. nov.* Lower Miocene, Egypt.

West, Newman imp.

THE

GEOLOGICAL MAGAZINE.

NEW SERIES. DECADE IV. VOL. VII.

No. I.—JANUARY, 1900.

ORIGINAL ARTICLES.

I.—On a New Species of Chelonian (*Podocnemis ægyptiaca*) from the Lower Miocene of Egypt.

By C. W. Andrews, B.Sc., F.G.S., of the British Museum (Natural History).

(PLATE I.)

THE occurrence of fossil reptiles in the Lower Miocene of Moghara in Egypt has already been referred to in a paper published in the last volume of this journal (1899, p. 481), where a short account of the deposits in which the remains are found has been given. The specimens which have been received from Captain H. G. Lyons, R.E., Director-General of the Egyptian Geological Survey, include bones and scutes of Crocodile, Trionyx, and of the Chelonian which forms the subject of the present notice. Of the two former the remains are too imperfect for determination, and further material is desirable; but in the case of the last it has been found possible to reconstruct the plastron and most of the carapace, and from these it can be shown that this Chelonian belonged to the Pleuradiran group, and is referable to the genus *Podocnemis*, forming a new species, to which the name *Podocnemis ægyptiaca* may be applied. At the present day the genus is found only in South America and Madagascar, but, as in many other cases in which the modern representatives of a group are confined to the Southern Hemisphere, where they may occur in widely separated areas, in the Tertiary period species existed in the Northern Hemisphere. In the present instance two species of *Podocnemis* have been recorded from the Lower Eocene of England and India—that from the former being *Podocnemis Bowerbanki* (=*Platemys Bowerbanki*; *Emys lævis*, Owen), from the London Clay of Sheppey; that from the latter, *Podocnemis indica*, from Nila in the Salt Range. The present species is interesting as showing that in early Miocene times the genus existed in Africa, whence probably it spread into Madagascar, now one of its headquarters.

Description of the Specimens.

The carapace of the type-specimen, as figured (Pl. I, Fig. 1), is very incomplete in its peripheral region, for, although some portions of the marginal bones are preserved, it has not been possible to fit them into their places. Of the remainder of the carapace the neurals 3 and 5 are wanting, 2 and 6 incomplete, all the costals are imperfect at their outer ends, and much of the posterior ones is broken away. The general form is somewhat depressed, and there is no trace of any keel. The neurals (*n*) were six in number, the first being the largest and the last

relatively very small. There are eight pairs of costals (*c*, 1–8), of which the last two meet in median suture; possibly also the sixth pair were only partly separated by the last neural. The positions of the facets for union with the inguinal and axillary buttresses of the plastron are marked + in Fig. 1 of the Plate. The furrows marking the boundaries of the horny plates are very distinct; the vertebral shields are somewhat balloon-shaped, and in their anterior half are nearly twice as wide as they are posteriorly. The outlines of three complete vertebrals are preserved and portions of two others.

The general form of the plastron is shown in Fig. 2, Pl. I. The entoplastral (*ent.*) is lozenge-shaped, with slightly convex posterior borders. There is a pair of small mesoplastrals wedged in between the outer ends of the hyo- and hypoplastra. The xiphiplastra (*xp.*) bear on their upper surfaces rugose prominences (Fig. 3), indicating the firm sutural union of the ischia (*is.*) and pubes (*pu.*) with the plastron. The posterior border of the plastron is notched.

There is a very small intergular (*i.g.*), the posterior end of which does not extend so far back as the anterior angle of the entoplastron, and only separating the gulars (*g.*) for about a third of their length. The sutures between the humerals and pectorals cross the entoplastron in front of its middle point. In the proportions and arrangement of these anterior plastral shields this species approaches *P. madagascariensis* very closely. The abdominal, femoral, and anal shields do not present any peculiarity.

The total length of the plastron is 33·5 cm.; the length of the bridge, 13·3 cm.; width of plastron immediately in front of bridge, 15·5 cm.

The existence of a firm sutural union between the pelvis and plastron shows that this Chelonian belonged to the Pleuradiran group, and the presence of mesoplastra further indicates that it is referable to the family Pelomedusidæ. In this family the mesoplastra are small and laterally situated in two genera, *Pelomedusa* and *Podocnemis*, to the latter of which the fossil approaches most nearly, and, as already mentioned, is in some respects extremely similar to *Podocnemis madagascariensis*.

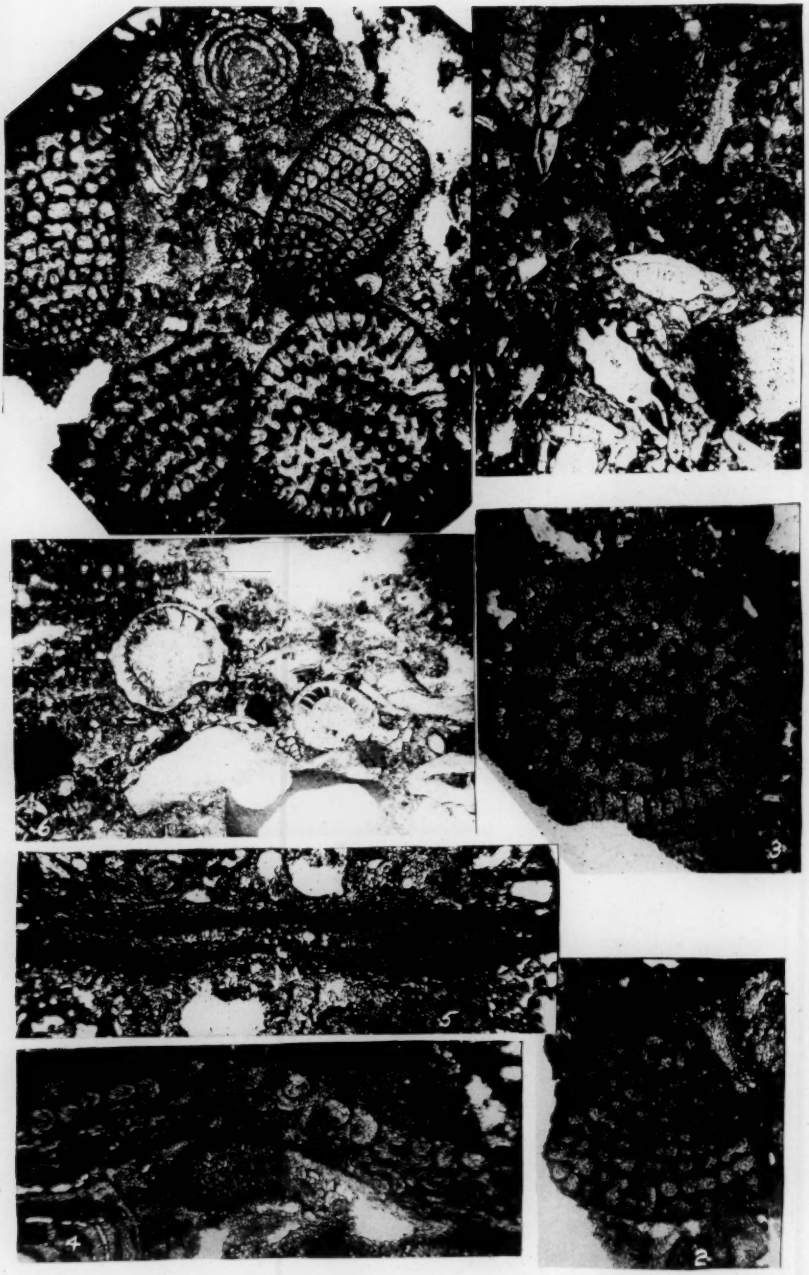
The remains of *P. ægyptiaca* seem to be very common at Moghara, and some of the specimens indicate that it attained a considerably greater size than the specimen now figured.

EXPLANATION OF PLATE I.

Carapace and Plastron of Podocnemis ægyptiaca (type-specimen).

Fig. 1.—Carapace (dorsal view). Fig. 2.—Plastron (ventral view).
Fig. 3.—Xiphiplastral region of plastron (upper surface).
(About one-third natural size.)

abd. Abdominal shields.
an. Anal shields.
c_{1-8}. Costal plates.
ent. Entoplastral plate.
ep. Epiplastral plate.
fem. Femoral shield.
g. Gular shield.
h. Humeral shield.
hp. Hypoplastral plate.
hy. Hyoplastral plate.
i.g. Intergular shield.
is. Surface for union with ischium.
mp. Mesoplastral plate.
n. Neural plate.
pec. Pectoral shield.
pu. Surface for union with pubis.
xp. Xiphiplastral plate.



F. C., PHOTO. MORGAN & KIDD, COLLOTYPE.

TERTIARY FORAMINIFERA FROM EGYPT.

II. — On a *Patellina*-limestone and another Foraminiferal Limestone from Egypt.

By F. Chapman, A.L.S., F.R.M.S.

(PLATE II.)

THE specimens dealt with in this paper were collected by the Officers of the Geological Survey of Egypt, and I have been requested by Dr. H. Woodward, on behalf of Captain H. G. Lyons, R.E., F.G.S., the Director-General, to give an account of the various species of Foraminifera met with during the progress of the Survey.

The *Patellina*-limestone.

These specimens bear the Survey label No. 11*c* (827). The rock occurs on a plateau between Cairo and Suez, the geological position of which Mr. Barron is inclined to consider as the base of the Miocene grits and marly clays (letter dated 29th July, 1899). The exact locality whence these samples came is situated six kilometres west of Camp 35, in lat. N. 30° 17′ 55″, long. E. 32° 18′ 14″.

The rock is of the greatest interest on account of the presence of a new species of *Patellina*, which constitutes a large proportion of the limestone. The relative abundance of the *Patellinæ* in the rock can be well seen in the photograph (Pl. II, Fig. 1) of a thin section taken haphazard from the rock-specimen. This genus appears to be hitherto quite unknown in the limestones of Egypt.

Besides *Patellinæ* there are other foraminifera associated with it in this rock, belonging to the genera *Biloculina*, *Miliolina*, *Orbiculina*, *Alveolina*, *Bigenerina*, *Discorbina*, *Truncatulina*, *Gypsina*, *Polytrema*, and *Nonionina*.

The limestone is ochreous-yellow to pale brown in colour. The matrix of the rock is somewhat spongy, cavities caused by chemical solution and recrystallization being seen here and there, whilst in section the foraminifera other than the *Patellinæ* frequently have a space between the wall of the test and the matrix by which it is partially filled. When the rock is crushed for the extraction of the smaller organisms the casts fall out, leaving the walls of the tests adhering to the matrix.

The microscopic structure of the enclosing rock-mass is distinctly crystalline, which condition is probably due to subsequent molecular disturbance of the calcareous mud in which the foraminifera were embedded, and which has resulted in the formation of a granular calcitic material, in which scalenohedra are an abundant crystalline form, especially on the borders of the cavities.

Besides foraminifera there are some obscure examples of polyzoa. An ostracod (*Bairdia*, described below) also occurs in some numbers, represented both in section and by a specimen isolated from the rock.

Scattered through the rock are some rounded grains of quartz averaging 1 mm. in diameter, and often containing strings of minute inclusions or gas cavities.

OSTRACODA.

Family BAIRDIIDÆ.

BAIRDIA, McCoy [1844].

BAIRDIA SUBDELTOIDEA (Münster).

Cythere subdeltoidea, Münster, 1830, Jahrb. Min., p. 64; 1835, p. 446.

Bairdia subdeltoidea (Münster), Jones & Sherborn, 1887, p. 387; idem, 1889, Mon. Tert. Entom., p. 16, pl. i, figs. 15*a*, *b*. Egger, 1895: Naturhist. Vereins Passau, Jahresb. 16, p. 42, pl. ii, figs. 20*a*, *b*.

The specimens found in the Egyptian limestone are of medium size, with the valves united. In the sections of the rock they occur with some frequency. The species has a rather wide range in time, since it is characteristic and common in all the Cretaceous deposits beginning at the Aptian, or Lower Greensand of England; and it also occurs in beds of Middle Eocene age at Bracklesham and in the older Pliocene of Northern Italy.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

FORAMINIFERA.

Family MILIOLIDÆ.

Subfamily MILIOLINÆ.

BILOCULINA, d'Orbigny [1826].

BILOCULINA BULLOIDES, d'Orbigny.

"Conchula minima, etc.," Plancus, 1739: De Conch. min. nat., p. 23, pl. ii, fig. 6.

Biloculina bulloides, d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 297, No. 1, pl. xvi, figs. 1–4; Modèle, No. 90.

B. Peruviana, id., 1839: Foram. Amér. Mérid., p. 68, pl. ix, figs. 1–3.

B. ringens (Lam.), Parker, Jones, & Brady, 1865: Ann. Mag. Nat. Hist., ser. III, vol. xvi, p. 35.

B. lucernula (*pars*), Schwager, 1866: Novara-Exped., Geol. Theil., vol. ii, p. 202, pl. iv, figs. 17*a*, *b*.

B. bulloides, d'Orb., Terquem, 1882: Mém. Soc. géol. France, sér. III, vol. ii, p. 153, pl. xxiii, fig. 38.

Miliolina ringens (Lam.), Goës, 1882: K. Svenska Akad. Handl., vol. xix, p. 131, pl. x, figs. 363–365, 386?

Biloculina bulloides, d'Orb., Brady (=*B. lucernula*, Schwager, Schlumberger), 1884: Rep. "Challenger," vol. ix, p. 142, pl. ii, figs. 5, 6. Schlumberger, 1887: Bull. Soc. géol. France, sér. III, vol. xv, pp. 574–579, pl. xv, figs. 10–13 and woodcuts 1–5. Egger, 1895: Abhandl. k. bayer. Akad. Wiss., vol. xviii, Abth. 2, p. 217, pl. i, figs. 16–18. Rupert Jones, 1895: Mon. Foram. Crag, pt. ii, pp. 101 and 102.

B. bulloides is quite a common species in the *Patellina*-limestone. On crushing the rock the little subspherical tests are seen amongst the débris, and projecting from the surfaces of the larger fragments. They often have the shell-wall perfect, and are occasionally noticed as casts. The contour of the test in these Egyptian specimens is very typical, having a globose penultimate chamber and a slightly elongated aboral neck. Passage forms occur which link this species with its more pyriform variety next described.

Although *B. bulloides* ranges throughout the Tertiary fossiliferous strata to recent times, yet the fossil forms seem to be distinct in some of their characters, as shown by Schlumberger.

? Lower Miocene: from a plateau between Cairo and Suez. Common.

BILOCULINA BULLOIDES, var. INORNATA, d'Orb.

Biloculina inornata, d'Orb., 1846: Foram. Foss. Vienne, p. 266, pl. xvi, figs. 7–9.

B. bulloides, d'Orb., var. *truncata-gracilis*, Reuss, 1867: Sitzungsb. Akad. Wiss. Wien, vol. lv, p. 69, pl. ii, fig. 2.

B. bulloides, var. *inornata*, d'Orb., Rupert Jones, 1895: Mon. Foram. Crag (Pal. Soc.), pt. ii, pp. 101–2, pl. vii, figs. 1*a–c*.

The slightly elongate variety of *B. bulloides* may be referred to *B. inornata* of the Vienna Tertiaries. It is not so common as the typical *B. bulloides* in this Egyptian limestone, but is represented, nevertheless, by several good examples.

Besides its original occurrence in the Miocene of the Vienna Basin, this variety has been found in many fossiliferous deposits of Pliocene age.

? Lower Miocene: between Cairo and Suez. Frequent.

MILIOLINA, Williamson [1858].

MILIOLINA OBLONGA (Montagu).

Vermiculum oblongum, Montagu, 1803: Test. Brit., p. 522, pl. xiv, fig. 9.

Miliolina seminulum (L.), var. *oblonga* (Montagu), Williamson, 1858: Recent Foram. Gt. Brit., p. 86, pl. vii, figs. 186, 187.

M. oblonga (Mont.), Brady, 1884: Rep. Chall., vol. ix, p. 160, pl. v, figs. 4*a*, *b*. De Amicis, 1893: Boll. Soc. Geol. Ital., vol. xii, fasc. 3, pp. 27, 178, 179, 317. Goës, 1894: K. Svensk. Akad. Handl., vol. xxv, No. 9, p. 110, pl. xx, figs. 850, 850*f*. Rupert Jones, 1895: Mon. Foram. Crag, pt. ii, p. 120, pl. iii, figs. 31, 32; pl. v, fig. 5. Millett, 1898: Journ. Roy. Micr. Soc., p. 267, pl. v, figs. 14*a*, *b*.

Examples of this somewhat variable species were found with both the triloculine and the quinqueloculine forms. The triloculine variation is more typical. The quinqueloculine form seems to be somewhat closely allied with *Miliolina alveoliniformis*, Brady, and also with Schlumberger's subgeneric type of *Pentellina*.

Miliolina oblonga dates back as far as the Eocene period, and it is found living at the present day, usually in shallow water.

? Lower Miocene: from a plateau between Cairo and Suez. Rare.

MILIOLINA SUBROTUNDA (Montagu).

Vermiculum subrotundum, Montagu, 1803: Test. Brit., pt. ii, p. 521.
Quinqueloculina subrotunda (Mont.), d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 302, No. 36.
Miliola (*Quinqueloculina*) *subrotunda* (Mont.), Parker & Jones, 1865: Phil. Trans., vol. clv, p. 411, pl. xv. fig. 38.
Miliolina subrotunda (Mont.), Brady, 1884: Rep. Chall., vol. ix, p. 168, pl. v, figs. 10, 11.
M. subrotunda (Walker & Boys), Goës, 1894: Kongl. Svenska Vet.-Akad. Handl., vol. xxv, p. 109, pl. xix, figs. 846, 847.
M. subrotunda (Mont.), Rupert Jones, 1895: Mon. Foram. Crag, pt. ii, p. 120, woodcut, fig. 9. Millett, 1898: Journ. Roy. Micr. Soc., p. 502.

The specimens from the Egyptian limestones are very typical.

As a fossil this species dates from Miocene times. It is an essentially shallow-water form at the present day, and this is the case with the other Miliolines recorded from the Egyptian Miocene limestone.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

MILIOLINA TRIGONULA (Lamarck).

Miliolites trigonula, Lamarck, 1804: Ann. du Muséum, vol. v, p. 351, No. 3. 1822: Anim. sans Vert., vol. vii, p. 612, No. 3.
Triloculina Austriaca, d'Orb., 1846: Foram. Foss. Vienne, p. 275, pl. xvi, figs. 25–27.
Miliolina trigonula (Lamarck), Williamson, 1858: Recent Foram. Gt. Brit., p. 83, pl. vii, figs. 180–182. Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 86, pl. xxiv (i), figs. 6*a–d*. Brady, 1884: Rep. Chall., vol. ix, p. 164, pl. iii, figs. 14–16. Sherborn & Chapman, 1889: Journ. Roy. Micr. Soc., p. 484, pl. xi, fig. 1. Terrigi, 1891: Mem. Roy. Com. Geol. Ital., vol. iv, pt. i, p. 66, pl. i, fig. 4. Goës, 1894: Kongl. Svenska Vet.-Akad. Handl., vol. xxv, p. 115, pl. xxii, fig. 870. Millett, 1898: Journ. Roy. Micr. Soc., p. 503.

There is some variability in the dimensions of the Egyptian specimens, but they are otherwise characteristic. Schwager has recorded this species from the cherty *Alveolina*-limestone, between Siut and Farâfrah; in the *Miliolina*-limestone of the Arabian Desert at Wady Natfe; also similar forms near Minieh and Mokattam.

M. trigonula dates from the Eocene period, and is also found fossil in Miocene strata and onwards to the present day.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

MILIOLINA INFLATA (d'Orbigny).

Triloculina inflata, d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 300, No. 10. Römer, 1838: Neues Jahrbuch, p. 393, pl. iii, fig. 72. Michelotti, 1841: Mem. Soc. Ital. Sci., vol. xxii, p. 299, pl. iii, fig. 11. D'Orb., 1846: Foram. Foss. Vienne, p. 278, pl. xvii, figs. 13–15.

Quinqueloculina inflata (d'Orb.), Parker, Jones, & Brady, 1871: Ann. Mag. Nat. Hist., ser. IV, vol. viii, p. 249, pl. viii, fig. 16.

Triloculina inflata, d'Orb., Terquem, 1878: Mém. Soc. géol. France, sér. III, vol. i, p. 56, pl. v (x), figs. 16*a*–18*b*. Idem, 1882: ibid., vol. ii, p. 165, pl. xvii [xxv], figs. 4–6.

Miliolina lucens, Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 87, pl. xxiv, figs. 7*a–d*.

The inflated varieties of the type *M. seminulum* may be referred to the above specific name. *M. inflata* is a common Tertiary form, and is most typical in the Eocene and Miocene formations. Schwager records his *M. lucens* from the cherty *Alveolina*-limestone and marl between Siut and Farâfrah; on the Nekeb-el-Farudj; in the upper beds of El Guss-Abu-Said, and in the *Alveolina*-limestone of Wady Natfe in the Arabian Desert.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

MILIOLINA SEMINULUM (Linné).

Serpula seminulum, Linné, 1767: Syst. Nat., 12th ed., p. 1,264, No. 791; 1788, 13th (Gmelin's) ed., p. 3,739, No. 2.

Vermiculum intortum, Montagu, 1803: Tert. Brit., p. 502.

Quinqueloculina seminulum (L.), d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 303, No. 44.

Miliolina seminulum, Williamson, 1858: Recent Foram. Gt. Brit., p. 85, pl. vii, figs. 183–185.

Quinqueloculina seminulum, Jones, Parker, & Brady, 1866: Foram. Crag, p. 9, pl. iii, figs. 35, 36.

Miliolina seminulum, Greene, 1871: Manual Protozoa, p. 15, fig. 3*g*.

Quinqueloculina semilunum [*seminulum*] (L.), Terquem, 1875: Anim. plage Dunkerque, fasc. 1, p. 40, pl. vi, fig. 8.

Miliolina seminulum (L.), Brady, 1884: Rep. Chall., vol. ix, pp. 157–160 (woodcuts, figs. 3*a–c*); pl. v, fig. 6. Sherborn & Chapman, 1886: Journ. Roy. Micr. Soc., ser. II, vol. vi, p. 742, pl. xiv, fig. 1. Rupert Jones, 1895: Mon. Foram. Crag, pt. ii, p. 116. Millett, 1898: Journ. Roy. Micr. Soc., p. 505.

M. seminulum is a common species in the *Patellina*-limestone from Egypt, and the specimens are well developed.

As a fossil this foraminifer dates from the Lower Eocene period, and it is also a well-known shallow-water species at the present day.

? Lower Miocene: from a plateau between Cairo and Suez. Common.

MILIOLINA POLYGONA (d'Orbigny).

Quinqueloculina polygona, d'Orb., 1839: De la Sagra, Hist. Phisiq., etc., Cuba, "Foraminifères," p. 198, pl. xii, figs. 21–23.

Miliolina seminulum (L.), Goës, 1882, "Ret. Rhiz. Caribb. Sea": Svenska Vet.-Akad. Handl., vol. xix, No. ix, figs. 353, 354.

Miliolina Gussensis, Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil., p. 85, pl. xxiv (i), figs. 5*a–d*.

M. polygona (d'Orb.), Goës, 1894: Svenska Vet.-Akad. Handl., vol. xxv, No. 9, p. 111, pl. xxx, figs. 854–854*g*; idem, 1896, Bull. Mus. Comp. Zool. Harvard, vol. xxix, No. 1, pt. xx, p. 83, pl. viii, figs. 11–18.

This species in the Egyptian limestone varies much as to size, but the specimens are constant in the characters of the test.

The specimens named *M. Gussensis* by Schwager were found in the argillaceous beds with *Operculina libyca* of El Guss-Abu-Said (Libyan Stage).

In recent soundings this form affects warm areas, usually in the neighbourhood of coral reefs. Goës found this species in the West Indies at a depth from 300 to 400 fathoms.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

Subfamily PENEROPLIDINÆ.

ORBICULINA, Lamarck [1816].

ORBICULINA ADUNCA (Fichtel & Moll).

Nautilus orbiculus, Fichtel & Moll, 1803: Test. Micr., p. 112, pl. xxi.

N. angulatus, idem: ibid., p. 113, pl. xxii.

N. aduncus, idem: ibid., p. 115, pl. xxiii.

Orbiculina adunca (Fichtel & Moll), Lamarck, 1816: Tabl. Encycl. et Méth., pl. cccclxviii, figs. 2*a–c*. D'Orbigny, 1839: Foram. Cuba (in Sagra's "Hist. phisiq. Cuba"), p. 81, pl. viii, figs. 8–14. Brady, 1884: Rep. Chall., vol. ix, p. 209, pl. xiv, figs. 1–13. Agassiz, 1888: Three Cruises "Blake," ii, p. 160, figs. 486, 487.

Both casts and perfect specimens of *Orbiculina* occur in the *Patellina*-limestone.

O. adunca is known from Eocene and Miocene rocks, and at the present time it is confined to fairly shallow water of warm areas.

? Lower Miocene: from a plateau between Cairo and Suez. Common.

Subfamily ALVEOLININÆ.

ALVEOLINA, d'Orbigny [1826].

ALVEOLINA ELLIPSOIDALIS, Schwager.

Alveolina ellipsoidalis, Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 96, pl. xxv (ii), figs. 1*a–i* and 2*a–c*.

Examples of the above species are quite common in the *Patellina*-limestone, and one perfect enough for identification was isolated

by crushing the rock. It is probable, but not quite certain in the absence of sections, that the *Alveolina Hauerii* of d'Orbigny[1] from the Miocene of Nussdorf is of the same type. Schwager's specimens came from the *Alveolina*-limestone of the Wady Natfe in the Arabian Desert (Libyan Stage).

? Lower Miocene: from a plateau between Cairo and Suez. Common.

ALVEOLINA LEPIDULA, Schwager. (Pl. II, Fig. 1.)

Alveolina lepidula, Schwager, 1883: Palæontographica, vol. xxx, Pal. Theil, p. 98, pl. xxv (ii), figs. 3*a–g*.

This species, viewed towards the septal face, gives an ovate, pointed outline. It was suggested by Schwager that it may represent an immature stage of the foregoing species. It was found by that author associated with *A. ellipsoidalis* from the Wady Natfe, Arabian Desert.

? Lower Miocene: from a plateau between Cairo and Suez. Very common.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

BIGENERINA, d'Orbigny [1826].

BIGENERINA CAPREOLUS (d'Orbigny).

Vulvulina capreolus, d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 264, No. 1, pl. xi, figs. 5, 6; Modèle, No. 59.

Schizophora Neugeboreni (?), Reuss, 1861: Sitzungsb. böhm. Gesellsch. Wiss., vol. ii, p. 13.

Grammostomum capreolus (d'Orb.), Parker & Jones, 1863: Ann. Mag. Nat. Hist., ser. III, vol. xi, p. 93.

Textilaria flabelliformis (young stage), Gümbel, 1868: Abhandl. bayer. Akad. Wiss., Cl. ii, vol. x, p. 647, pl. ii, figs. 83*a, b*.

Venilina Hæringensis, Gümbel, 1868: ibid., p. 649, pl. ii, fig. 84 (*bis*), *a, b*.

Schizophora Hæringensis, Hantken, 1872: Mittheil. Jahrb. ungar. geol. Anstalt., vol. i, p. 136, pl. ii, figs. 17*a, b*.

Bigenerina capreolus (d'Orb.), Brady, 1884: Report Chall., vol. ix, p. 372, pl. xlv, figs. 1–4.

A good vertical section of the above species occurs in one of the slides. It is recognized by the pointed aboral end and the fine arenaceous structure of its test.

As a fossil *B. capreolus* makes its first appearance in the Eocene of the Bavarian Alps; it was also found in the *Clavulina-Szaboi* beds of Hungary; and it is known from the newer Tertiaries of Italy (Mio-Pliocene). The depths at which this species occurs in recent deposits ranges from fairly shallow water to about 700 fathoms. At the present day it is generally found in the North Atlantic Ocean.

? Lower Miocene: from a plateau between Cairo and Suez. One specimen.

[1] Foram. Foss. Vienne, 1846, p. 148, pl. vii, figs. 17, 18.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

PATELLINA, Williamson [1858].

GENERIC SYNONYMY.[1]

Orbitolites, pars, Lamarck [1801], Defrance.
Madreporites, Blumenbach [1805].
Orbulites, Lamarck [1816].
Cyclolina, pars, d'Orbigny [1846], Carter.
Orbitolina, d'Orbigny [1847], Bronn, d'Archiac, Gras, Parker & Jones, Carter, Martin.
Orbitulites, Bronn [1848].
Patellina, Williamson [1858], Carpenter, Parker & Jones, Brady, Alcock, Parfitt, G. M. Dawson, Miller & Van den Broeck, Robertson, Schulze, Terquem, Siddall, Berthelin, Shone, Wright, Fritsch, Hantken, Zittel, Howchin, Chapman.
Conulites, Carter [1861].

The above synonymy is given in order that the claim of *Patellina* as the name of the genus may be readily seen. The subject of the nomenclature has already been discussed by Carpenter, Parker, & Jones,[2] and, later, by Professor Rupert Jones.[3]

It will perhaps be useful to point out briefly the shortcomings of the various names earlier than *Patellina*.

Orbitolites is now retained for one of the two types originally confused under the same name.

Madreporites does not stand according to the Strickland Rule No. 11, since it implies a false relationship; moreover, the name was previously used by Deluc (1802) in connection with *Orbitolites*.

Orbulites, an improved form of *Orbitolites*, was used by Lamarck when describing specimens belonging to that and the present genus.

Cyclolina used to denote a depressed, complanate form, probably of the present genus, but by no means typical.

Orbitolina appears to have been originally used in the sense of a recent form of *Orbitolites*, which was at the time thought to be a fossil genus, the terminations *ina* and *ites* being used by Lamarck and others for recent and fossil specimens respectively. This generic term has been largely used on the Continent to designate the *Patellinæ* with large tests and thick shell-walls, and which are so common in various Cretaceous beds in France, Spain, and Switzerland. Should these particular forms be proved to possess hyaline or tubulated shell-structure, there is no ground for retaining the name even as an isomorphic arenaceous group with *Patellina*.

Orbitulites is evidently a misspelling.

[1] For references see Sherborn's Index to Genera and Species of the Foraminifera, 1896.

[2] Introd. Foram., 1862, p. 229. Also Ann. Mag. Nat. Hist., ser. III, vol. xii (1863), p. 212.

[3] Cat. Foss. Foram. Brit. Mus., 1882, p. 84.

Patellina was well described by Williamson, who took the typical little *P. corrugata* for the purpose. This form is quite hyaline throughout. In most cases the large fossil forms above referred to show very little evidence of hyaline structure, but it is extremely probable that this absence of tubulation is due to recrystallization of the calcitic substance of the shell-wall. In the Egyptian *Patellina*, however, by careful examination under high powers, a distinct but extremely fine tubulation can be made out in portions of the shell-wall better preserved, the tubules sometimes radiating in a characteristic manner.

Conulites was founded on specimens of *Patellina* from India, but described at later date than Williamson's type-form. This form approximates very closely to the Egyptian species in general structure.

The whole group of the *Patellinæ* require a systematic and exhaustive study, and this I believe is being undertaken by Mr. A. Vaughan Jennings, who possesses a valuable collection of material for the purpose. I will here express my sincere thanks to Mr. Jennings for much assistance in making comparison with specimens of *Patellina* from his collection.

PATELLINA EGYPTIENSIS, sp. nov. (Pl. II, Figs. 1–3.)

Test conoidal, in vertical section nearly equilateral, the two sides slightly convex, straight, or incurved in the middle of the test; base circular in outline, and with a slightly convex surface; peripheral edge rounded. The chambers are arranged on two plans, consisting (1) of an internal cone of chamberlets arranged at the apex in a spiral, and afterwards annular, or discoidal, each disc being subdivided into chamberlets by labyrinthic or irregular septa, the chamberlets alternate with those above and below; (2) of a cortical or external layer of rectangular chambers, partially subdivided by imperfect septa attached to the outer wall of the chamber and projecting inwards. The spire at the apex or aboral end of the test is large and simple, consisting of about one and a half turns, and in some cases the primordial sphere is well shown. The primordial chamber is most frequently megalospheric, measuring about $\frac{1}{60}$ inch (·416 mm.) in diameter; one sphere of the microspheric type measures $\frac{1}{196}$ inch (·26 mm.) in diameter.

In vertical section the cone is seen to be divided laterally by curved floors parallel with the convex surface of the base. These are subdivided somewhat irregularly by vertical septa in the central area. Average height of test, $\frac{1}{5}$ inch (5 mm.); average diameter at the base, $\frac{1}{5}$ inch (4·16 mm.).

AFFINITIES.—The present species differs considerably in point of structure from the large Cretaceous *Patellinæ*, the chief distinction of the latter forms being the more or less hemispherical or spherical shape of the chambers constituting the cortical layer. In the Tertiary specimens the cortical chambers are decidedly rectangular.

I have lately taken the opportunity of examining the specimens

of '*Conulites*' *Cooki*,[1] both in the collection at the British Museum (Natural History)[2] and in the Carter Collection at the Geological Society, in order to make a comparison of the Indian with the Egyptian species. In the collection at the Geological Society's Museum the best specimens of *Patellina Cooki* are mounted on slide No. 40 of the Carter Collection, and are numbered 2 (from Kelat), 3 (from Sind), and 4 (from Arabia). The sections of *P. Cooki* show the cortical layer to consist of rectangular chambers, but these, unlike the Egyptian specimens, are without the secondary imperfect septa or dissepiments seen in the latter.

Some West Indian specimens of Miocene age kindly lent me by Mr. Jennings show this secondary septation of the cortical layer, but the chambers in these are more crowded and narrower than in *P. Egyptiensis*, and the species is probably new.

It is interesting to note that *Patellina Cooki* is associated with the following foraminifera in the Indian limestone as given by Carter in the paper above mentioned, namely: *Alveolina elliptica*, *Nummulites obesa*, *N. perforata*, *N. Carteri*, *Assilina exponens*, *A. spira*, and *Orbitoides dispansa*. The limestone in which these foraminifera occur appear to belong to the Kirthar Group (Eocene).[3] In these Eocene beds the shell-structure exhibits the simplest plan. In the Egyptian beds, probably Lower Miocene, we have the intermediate stage in the development of the cortical layer. Finally, in the West Indian Miocene, presumably newer in age, the transition of the outer chambers is carried out still further.

Thus there appears to be a progression of this form in a westerly direction.

? Lower Miocene: from a plateau between Cairo and Suez. Very abundant, forming about 50 per cent. of the bulk of the rock.

DISCORBINA, Parker & Jones [1862].

DISCORBINA, sp., near D. GLOBULARIS (d'Orbigny).

Rosalina globularis, d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 271, pl. xiii, figs. 1–4; Modèle, No. 69.

Discorbina globularis (d'Orb.), Parker, Jones, & Brady, 1865: Ann. Mag. Nat. Hist., ser. III, vol. xvi, p. 30, pl. ii, fig. 69.

Our specimen occurs in a section of the rock, but there is little doubt, from the thick peripheral wall and globular segments, that it is referable to the above species. It is a well-known fossil in Middle Eocene, Miocene, and Pliocene beds.

? Lower Miocene: from a plateau between Cairo and Suez. One specimen.

[1] See Carter, 1861, Journ. Bombay Br. Roy. As. Soc., vol. vi, p. 83. Also Ann. Mag. Nat. Hist., ser. III, vol. viii, p. 457, pl. xv, fig. 7.

[2] To Mr. R. B. Newton and Mr. W. R. Jones I am indebted for their kind attention when examining these specimens at the British Museum and the Geological Society.

[3] See Manual of Geology of India, 1893, Medlicott & Blanford, 2nd ed., revised by R. D. Oldham, pp. 305–7.

TRUNCATULINA, d'Orbigny [1826].

Truncatulina Ungeriana (d'Orbigny).

Rotalina Ungeriana, d'Orb., 1846: Foram. Foss. Vienne, p. 157, pl. viii, figs. 16–18.

Truncatulina Ungeriana (d'Orb.), Reuss, 1866: Denk. Akad. Wiss. Wien, vol. xxv, p. 161, No. 10. Brady, 1884: Rep. Chall., p. 664, pl. xciv, figs. 9*a–c*.

The example found is very typical, and has the form of the test well preserved; it was obtained by powdering the rock. The above species makes its appearance in beds of Cretaceous age, and it occurs commonly throughout the Tertiary formations.

? Lower Miocene: from a plateau between Cairo and Suez. One specimen.

Subfamily Tinoporinæ.

GYPSINA, Carter [1877].

Gypsina crassitesta, sp. nov. (Pl. II, Fig. 4.)

Test hyaline and adherent; coarsely perforate; consisting of series of dome-shaped segments overlying one another alternately and in about five or more successive layers. The first series of chambers more spherical than the later ones. The test is adherent to thin shell fragments or consolidated pieces of sand. Average diameter of the chambers, $\frac{1}{36}$ inch (·26 mm.). The largest specimen found measures $\frac{9}{25}$ inch (9 mm.) in length; height, $\frac{1}{33}$ inch (·75 mm.).

The recent *Gypsina inhærens* (Schultze)[1] has a similar habit of growth to this species, but it is usually much thinner in its shell-wall. The present species has coarse tubuli, such as is often present in *Gypsina*. The nature of the thick walls also reminds one of a similar character seen in *Carpenteria*. *Gypsina vesicularis*, var. *discus*, Goës,[2] may also be compared with the above species with regard to the depressed form of the test, especially in one of our specimens, where the peripheral edge is neatly rounded off.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

POLYTREMA, Risso [1826].

Polytrema papyracea, sp. nov. (Pl. II, Fig. 5.)

Test adherent, consisting of layers of somewhat acervuline but much elongated chambers, extending along the plane of attachment. The test often attains the length of $\frac{1}{4}$ inch (6·25 mm.); greatest thickness, $\frac{1}{36}$ inch (·694 mm.).

A passage form between this species and the well-known recent *Polytrema miniaceum* (L.) has been found in certain Tertiary and recent limestones, and will shortly be described. The present species is distinguished by its limited extent and compressed lenticular shape.

[1] *Acervulina inhærens*, Schultze, 1854: "Organismus Polythal.," p. 68, pl. vi, fig. 12.

[2] Bull. Mus. Comp. Zool. Harvard, 1896, vol. xxix, No. 1 (xx), p. 74, pl. vii, figs. 4–6.

? Lower Miocene: from a plateau between Cairo and Suez. Frequent.

Family NUMMULINIDÆ.

Subfamily Polystomellinæ.

NONIONINA, d'Orbigny [1826].

Nonionina Boueana, d'Orbigny.

Nonionina Boueana, d'Orbigny, 1846: Foram. Foss. Vienne, p. 108, pl. v, figs. 11, 12.

This species is represented both by casts and sections in the Egyptian limestone. In the casts the retral processes of the segments are faithfully reproduced, and the umbilical protuberance is well shown. The general form of the test is subcircular, compressed, with a rather sharp keel, and numerous narrow chambers.

Fossil specimens of this shallow-water form have been recorded from the Oligocene of Germany and the Miocene of the Vienna Basin and Southern Italy; and I have lately identified a variety of this species in the Miocene of California.

? Lower Miocene: from a plateau between Cairo and Suez. Common.

With regard to the age of the foregoing species of foraminifera in the *Patellina*-limestone, should the exact stratigraphical horizon of the rock as Lower Miocene be confirmed, it is of much interest to note the general aspect of the fauna, which strongly tends to confirm this idea, although there are one or two exceptions, such as the presence of *Alveolinæ* found by Schwager much lower in the series (Libyan Stage) in Egypt. Since no Nummulites have been observed in our rock-specimens we cannot but regard the occurrence of the *Alveolinæ* as indicating an upward range of considerable extent.

Limestone with *Operculina*, etc.

These specimens are labelled Box D, 5, 6, and 7 (1,257), near Erment, right bank of Nile Valley. Captain Lyons considers these beds to be of Pliocene age. The colour of the limestone is of a pale cream to a whitish tint. The foraminifera are not numerous in this rock, but *Operculina* may be detected on the fractured surfaces. In section the rock is a fine granular or crystalline limestone, with some included fragments of a denser and somewhat amorphous-looking limestone scattered through it, especially in specimen D 6. There are also traces of lamellibranch shells and echinoderm spines. The organisms in this rock are deposited very uniformly, their length coinciding with the plane of bedding, so that the sections taken at right angles to one another show the shells cut in two directions, longitudinal and transverse, in the separate slides. The foraminifera are fairly numerous, but rather small, and comprise the genera *Textularia*, *Globigerina*, *Gypsina*, *Amphistegina*, and *Operculina*.

FORAMINIFERA.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

TEXTULARIA, Defrance [1824].

TEXTULARIA SAGITTULA, Defrance.

Textularia sagittula, Defrance, 1824: Dict. Sci. Nat., vol. xxxii, p. 177; vol. liii, p. 344; Atlas Conch., pl. xiii, fig. 5. Brady, 1844: Rep. Chall., vol. ix, p. 361, pl. xlii, figs. 17, 18.

Several sections of this species occur in the limestone. It is easily recognized by its elongated contour and numerous chambers.

T. sagittula has a wide range in time, being known as far back as the Aptian.

Pliocene: near Erment, right bank of Nile Valley. Frequent.

TEXTULARIA AGGLUTINANS, d'Orbigny. (Pl. II, Fig. 6.)

Textularia agglutinans, d'Orb., 1839: Foram. Cuba, p. 136, pl. i, figs. 17, 18, 32–34. Brady, 1884: Rep. Chall., vol. ix, p. 363, pl. xliii, figs. 1–3.

The specimen found in the limestone from Egypt is typical in form, but rather small. In the fossil condition this species occurs as far back as the Carboniferous Limestone formation.

Pliocene: near Erment, right bank of Nile Valley. One specimen.

Family GLOBIGERINIDÆ.

GLOBIGERINA, d'Orbigny [1826].

GLOBIGERINA CONGLOBATA, Brady.

Globigerina conglobata, Brady, 1879: Quart. Journ. Micr. Sci., vol. xix, N.S., p. 72; idem, 1884, Rep. Chall., vol. ix, p. 603, pl. lxxx, figs. 1–5; pl. lxxxii, fig. 5.

The examples of the above species found in the *Operculina*-limestone are fairly typical, but are somewhat rounder in outline than recent specimens. *G. conglobata* appears to make its first appearance in beds of Miocene age.

Pliocene: near Erment, right bank of Nile Valley. Frequent.

Family ROTALIIDÆ.

Subfamily TINOPORINÆ.

GYPSINA, Carter [1877].

GYPSINA VESICULARIS? (Parker & Jones).

Orbitolina vesicularis, Parker & Jones, 1860: Ann. Mag. Nat. Hist., ser. III, vol. vi, p. 31, No. 5.

Gypsina vesicularis (Parker & Jones), Carter, 1877: Ann. Mag. Nat. Hist., ser. IV, vol. xx, p. 173.

There is a fragment of a *Gypsina* occurring in one of our slides, which seems to come nearest to the structure seen in *G. vesicularis*; on the other hand, there is just the possibility that it is an irregular

example of the more regularly-built *G. globulus* (Reuss). Both species date from the Miocene.

Pliocene: near Erment, right bank of Nile Valley. A fragment.

Family NUMMULINIDÆ.

Subfamily NUMMULITINÆ.

AMPHISTEGINA, d'Orbigny [1826].

AMPHISTEGINA LESSONII, d'Orbigny.

Amphistegina Lessonii, d'Orb., 1826: Ann. Sci. Nat., vol. vii, p. 304, No. 3, pl. xvii, figs. 1–4; Modèle, No. 98.

A. mamillata, d'Orb., 1846: Foram. Foss. Vienne, p. 208, pl. xii, figs. 6–8.

A. rugosa, id.: ibid., p. 209, pl. xii, figs. 9–11.

A. gibbosa, Williamson, 1851: Trans. Micr. Soc. Lond., ser. I, vol. iii, p. 110, pl. xvii, figs. 1, 2.

A. Lessoni, d'Orbigny: Parker, Jones, & Brady, 1865, Ann. Mag. Nat. Hist., ser. III, vol. xvi, p. 34, pl. iii, fig. 92.

A. semicostata, Kaufmann, 1867: Geol. Beschreib. des Pilatus, p. 149, pl. viii, fig. 18.

Hemistegina rotula, id.: ibid., p. 150, pl. viii, fig. 19.

A. Lessonii, d'Orb., Moebius, 1880: Foram. Mauritius, p. 99, pl. x, figs. 10–14; pl. xi, figs. 1–3.

A. Parisiensis, Terquem, 1882: Mém. Soc. géol. France, sér. III, vol. ii, Mém. iii, p. 124, pl. xiii, figs. 3*a*, *b*.

A. Lessonii, d'Orbigny, Brady, 1884: Rep. Chall., vol. ix, p. 740, pl. cxi, figs. 1–7.

The above synonymy refers especially to the thick varieties of *A. Lessonii*, since the examples met with in the *Operculina*-limestone belong to that group. The specimens are well-grown, and exhibit in all cases a well-developed cone of non-tubulous shell material.

Typical specimens of *A. Lessonii* date from the Eocene period, and they abound in some rocks of Miocene and Pliocene ages.

Pliocene: near Erment, right bank of Nile Valley. Frequent.

OPERCULINA, d'Orbigny [1826].

OPERCULINA AMMONOIDES (Gronovius). (Pl. II, Figs. 6, 7.)

Nautilus ammonoides, Gronovius, 1781: Zooph. Gron., p. 282, No. 1,220, and p. v (expl. Tab.).

N. Balthicus, Schroeter, 1782, Naturforscher, vol. xvii, p. 120; 1783, Einleitung, vol. i, p. 20, pl. i, fig. 2.

Operculina complanata (Defrance), Parker & Jones, 1857: Ann. Mag. Nat. Hist., ser. II, vol. xix, p. 285, pl. xi, figs. 3, 4.

O. ammonoides (Gronovius), Parker & Jones, 1861: Ann. Mag. Nat. Hist., ser. III, vol. viii, pp. 229, 230.

Brady, 1884: Rep. Chall., vol. ix, p. 745, pl. cxii, figs. 1, 2.

A. Silvestri, 1893: Mem. Pontif. Accad. N. Lincei, vol. ix, p. 217, pl. vi, fig. 5.

Rupert Jones, 1897: Mon. Foram. Crag, pt. iv, p. 364, pl. vii, figs. 34*a*, *b*. Also, var. *curvicamerata*, Jones, ibid., p. 365, pl. v, fig. 33.

The Egyptian specimens are neat and typically shaped. The septation, however, is rather more crowded and narrower than usual. In vertical section the test appears to be somewhat strongly limbate. In the limestones from near Erment this species is very common, but does not constitute a large proportion of the rock.

It is interesting to note that the previous geological occurrences of *O. ammonoides* agree with the age of these present rocks, since it has been met with in beds not older than the Pliocene of Calabria; it was also found in the English Coralline Crag, and it has been noted from the Pleistocene of Norway. As a recent organism it occurs in fairly shallow water, and has a wide geographical range, including the Mediterranean and the Gulf of Suez.

Pliocene: near Erment, right bank of Nile Valley. Very common.

EXPLANATION OF PLATE II.

Fig. 1.—Limestone with *Patellina Egyptiensis*, sp. nov., and *Alveolina lepidula*, Schwager. ? Lower Miocene: between Cairo and Suez. × 12.

Fig. 2.—Vertical sections of *Patellina Egyptiensis*, showing the primordial spire. ? Lower Miocene: between Cairo and Suez. × 16.

Fig. 3.—Basal section of *Patellina Egyptiensis*, showing the central and cortical arrangement of the septa. ? Lower Miocene: between Cairo and Suez. × 16.

Fig. 4.—*Gypsina crassitesta*, sp. nov., vertical section. ? Lower Miocene: between Cairo and Suez. × 16.

Fig. 5.—*Polytrema papyracea*, sp. nov., median section. ? Lower Miocene: between Cairo and Suez. × 16.

Fig. 6.—Limestone with *Operculina ammonoides* (Gronovius) in median section, and *Textularia agglutinans*, d'Orb. From specimen D 5. Pliocene: near Erment, right bank of Nile Valley. × 13.

Fig. 7.—Limestone with *Operculina ammonoides* (Gronovius) in vertical section. From specimen D 5. Pliocene: near Erment, right bank of Nile Valley. × 15.

SPECIES OF FORAMINIFERA DESCRIBED IN THIS PAPER.

1.	*Biloculina bulloides*, d'Orb.	? L. Miocene: between Cairo and Suez.
2.	,, ,, var. *inornata*, d'Orb.	,, ,, ,,
3.	*Miliolina oblonga* (Montagu)	,, ,, ,,
4.	,, *subrotunda* (Montagu)	,, ,, ,,
5.	,, *trigonula* (Lam.)	,, ,, ,,
6.	,, *inflata* (d'Orb.)	,, ,, ,,
7.	,, *seminulum* (Linné)	,, ,, ,,
8.	,, *polygona* (d'Orb.)	,, ,, ,,
9.	*Orbiculina adunca* (Fichtel & Moll)	,, ,, ,,
10.	*Alveolina ellipsoidalis*, Schwager	,, ,, ,,
11.	,, *lepidula*, Schwager	,, ,, ,,
12.	*Textularia agglutinans*, d'Orb.	Pliocene: near Erment.
13.	,, *sagittula*, Defrance	,, ,,
14.	*Bigenerina capreolus* (d'Orb.)	? L. Miocene: between Cairo and Suez.
15.	*Globigerina conglobata*, Brady	Pliocene: near Erment.
16.	*Patellina Egyptiensis*, sp. nov.	? L. Miocene: between Cairo and Suez.
17.	*Discorbina globularis*? (d'Orb.)	,, ,, ,,
18.	*Truncatulina Ungeriana* (d'Orb.)	,, ,, ,,
19.	*Gypsina vesicularis*? (Parker & Jones)	Pliocene: near Erment.
20.	,, *crassitesta*, sp. nov.	? L. Miocene: between Cairo and Suez.
21.	*Polytrema papyracea*, sp. nov.	,, ,, ,,
22.	*Nonionina Boueana*, d'Orb.	,, ,, ,,
23.	*Amphistegina Lessonii*, d'Orb.	Pliocene, near Erment.
24.	*Operculina ammonoides* (Gronovius)	,, ,,

OSTRACODA.

	Bairdia subdeltoidea (Münster)	? L. Miocene: between Cairo and Suez.

III.—Modern Denudation in North Wales.

By J. R. Dakyns.

THE subject of denudation is so important that I propose giving a few instances of denudation and of the transport of material that have actually come under my own observation or that of my friends. Where one sees the same familiar crags and pinnacles year after year, apparently quite unchanged, one may perchance fancy that denudation is at a standstill; but anyone who, in scrambling across the screes that clothe many a steep hillside, finds them moving beneath his feet, or perhaps has clattering about his ears a shower of stones dislodged by some wandering sheep, will at once perceive that it is not so: for it is obvious that if the mere tread of such a small beast as a sheep, shepherd or other pedestrian, can set scree rolling downhill, it must be in a very unstable state, and may be expected to move in a conspicuous manner under more potent forces than the tread of animals. Observation shows that this is the case. Not a year passes without some conspicuous fall of scree or of solid rock, owing chiefly to great downpours of rain. Leaving general statements, I will now give actual instances of the fall of rock or movement of scree that have recently taken place in the Snowdon district.

In the Summer of 1897 a large mass of earth and rock débris was washed by heavy rain down the hillside overlooking the east end of Llyn Llydaw, leaving a conspicuous scar which is still quite distinct. A similar scar close by, which is actually marked on the Ordnance six-inch map, was doubtless formed in a similar manner. Later on, in August, under another downpour of rain, a similar scar was formed on the Glyder near the head of Llanberis Pass.

In June, 1898, after a great deal of wet weather, while the summits were still enveloped in mist, I was scrambling along the slope of Lliwedd, above Cwm Llan, when I was startled at hearing from the side of Snowdon a noise like that of an explosion, followed by the sound of falling rocks. Turning quickly round, I saw issuing from the mist a quantity of earth and stones rushing down the mountain-side, and leaving long trails ploughed out of the loose material clothing the steep slope. Going up next day I found that a large mass of rock, weighing several hundred tons, had slipped down the hillside. The landslip was evidently due to a tiny rill having been swollen by the recent rains and having washed away some material supporting the highly weathered rocks, whose points of support then gave way with snaps like explosions of gunpowder. I once saw a somewhat similar fall of rocks in Norway caused by a thunder-shower. In August, 1899, during heavy rain, a long conspicuous scar was formed in scree on the side of Yr Aran. On November 3rd, the day of the great gale, when from fifteen to twenty streams were tearing down the mountain-sides, where usually there are only two or three, the high-level footpath to Snowdon was in three places either completely washed away or obliterated by being overwhelmed with stuff washed down the side

of Crib y Ddysgl. A few days after this, on going to seek shelter from rain in an old adit level, where I had often sheltered two years ago, I found it completely covered with screes, which had either come down in a similar manner previously or had gradually accumulated during the last two years. Another old level, which was open when I was a boy, has long since been quite covered by scree.

A long red scar is to be seen on the hillside between Lliwedd and Galt y Wenallt: this was formed in March some years ago by an avalanche caused by the sudden melting of the winter's snow under heavy rain. A friend of mine saw and heard it come down with a roar like thunder.

Another cause of the fall of rocks is lightning. I often see freshly broken rocks that look as if they must have been broken by lightning: such a one I noticed the other day below Crib Goch, which had probably been struck by lightning during the thunderstorm that occurred on the 20th of July, 1899; but it is not often that we actually know as a fact that such and such a rock has been struck by lightning. During the great thunderstorm that occurred in North Wales in the middle of August, 1898, a mass of rock was broken and thrown down near Llyn Teyrn. This is known to have been done by lightning, as it was not there till after the storm. It is still quite distinct.

It will thus be seen that scree is perpetually moving down to a quite conspicuous extent under the influence of water, and that large landslips and falls of rock are also caused by heavy rain and by lightning. I have not had an opportunity of observing in Wales the transport of stones by ordinary mountain torrents; but doubtless such torrents behave in Wales as similar streams do in Yorkshire, about which I happen to know something. I once lived at Kettlewell in Craven, in a room overlooking a mountain torrent. I had not been there very long before there was a deal of heavy rain; and one night, after all the village folk had gone to bed, I heard a bumping noise as if a heavy cart were jolting over a rough road; so, being surprised that anyone should be driving a cart at dead of night, I opened the window and looked out, and I then discovered that the noise was caused by boulders bumping against one another as they were swept down by the beck that flowed under my window. Whenever there was heavy rain on the hills, that bumping noise was heard. The beck, when in spate, which it often was, invariably rolled great stones down to the river Wharfe. No doubt mountain streams in Wales and in other hilly countries do likewise. I may here remark that this transport of stones may go on in clear water. In such a country as the volcanic parts of Cumberland and Westmorland, where there is no shale, very little peat, and all the rocks are hard, a stream, even when in spate, will run quite clear, but it is hurrying stones on along its bottom all the same. The effect of this may be seen in many places in the great spreads of gravel that occur where a mountain stream enters a river valley, as for instance where such a stream enters the valley of the

Aire from the hills above Kildwick and Conouley. I have given the above-mentioned observations to prove that there is now going on a steady transport of material, but the same conclusion is manifest to the reason, for there are places on the mountains where the rock is conspicuously bare, naked, and fresh-looking, being free from asperities and from vegetable growth; such spots, reason tells us, are the places where there is a perpetual or oft repeated fall of stones from above. There is such a naked rock on Clogwyn y Garnedd, under the summit of Snowdon; and though I have not actually seen stones falling there, I am as sure that the naked appearance of the rock is due to falling stones as if I had seen them fall. Such bare places on the mountain-sides are very conspicuous in some parts of Norway; and the natives tell you that they are due to 'stane scree.'

Another sign that a rock is now wasting away is this: if the ground beneath a cliff is thickly strewn with blocks of the same rock as that of which the cliff is composed, you may be quite sure that the cliff is now wasting away. A geologist must be careful how he hammers such a cliff at its foot, for even a slight blow of his hammer may bring down a mass of rock on to his head. Again, the spiky character of a serrated ridge is proof that the ridge is wasting away. Such wasting away is mainly due to frost; and I have noticed that in the Spring the mountain-sides are in a more crumbly and unstable state than at any other time of the year. This is doubtless due to the winter frosts. I have now said enough to show that denudation is steadily going on, though its amount may be small in comparison with the size of the hills.

IV.—On Sandstone Pipes in the Carboniferous Limestone at Dwlban Point, East Anglesey.

By Edward Greenly, F.G.S.

THE low, but rocky headland of Dwlban Point forms the western corner of Red Wharf Bay, on the east coast of Anglesey;[2] and is on the coastline of the principal tract of Carboniferous rocks in the island, not very far from the boundary fault which runs out to sea beneath the sands of the bay. The Carboniferous Limestone near the Point is for the most part a light-grey, crystalline rock, with abundant crinoids, corals, and other marine fossils. There are, however, four beds of sandstone, varying from 2 to 9 feet thick, and some of the Limestone itself also contains scattered grains of quartz. The sandstones are clean white rocks, generally fine, but with occasional thin seams of small pebbles.

Now the foreshore at Dwlban Point is composed of a massive bed of light-grey, crystalline Limestone. The surface of this bed, at a little creek close to the headland, is pierced by a large number of

[1] Abstracts of this and of the succeeding paper were read before the British Association, Dover, 1899.

[2] During the first examination and the mapping of this ground I was accompanied by my friend Mr. J. R. Dakyns. I should like to add also that most of the phenomena here described were noticed more than twenty years ago by Mr. G. H. Morton, F.G.S.

circular pits, varying from 1 foot to 7 feet in diameter. The margins of these having been glaciated, they open out in trumpet-shaped forms, but each can be seen to be, or to have been, filled with a plug of fine white sandstone, descending into the Limestone at right angles to the bedding. (See Figures illustrating the succeeding paper.)

These plugs can be seen in various stages of denudation. Some have been worn down flush with the surrounding Limestone, and some of the smaller ones have been excavated so as to leave an almost empty pit or pothole with a little sandy matter in the bottom. In one part of the shore, however, the plugs have been left standing each in its circular pit, some 4 or 5 feet above the level of the surrounding rock (Fig. 1); and the foreshore here presents

Fig. 1.—Sandstone Pipe in Carboniferous Limestone, Dwlban Point, Anglesey. Looking N.N.W.

a most extraordinary appearance, great masses suggestive of gigantic fossil corals, or of the Paramoudras of the Chalk, standing up from the rocky ledges, while others, torn out by the sea, lie prostrate in all directions.

The Limestone is here the highest bed seen, but as we proceed a few yards to the S.S.E. in the direction of the dip (which is at about 4°–5°) a bed of sandstone, about 2 feet thick, comes on above, forming the foreshore in its turn as the beds come down; and a little further still, in a low cliff, this is surmounted by about 7 feet of dark shale, and this by another Limestone of ordinary type, some 8–10 feet in thickness. (Fig. 2.)

Now at the exposed junction between the piped or lower Limestone and the overlying sandstone, there are numerous pipes, and the material of their plugs can be seen in cross section to be continuous with that of the sandstone above. There is no sign of

collapse in this bed of sandstone; indeed, the upper surface of the bed is in most cases gently domed upwards over the openings of the pipes, so as to present a hummocky surface on the foreshore. In some cases also there is a domed joint or crack in the sandstone over the head of the plug.

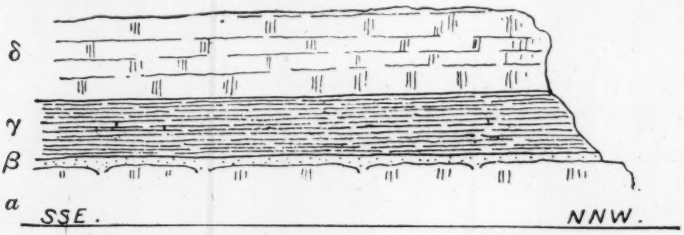


Fig. 2.—Diagram Section at Dwlban Point.
α, Piped Limestone; β, Sandstone; γ, Shale; δ, Upper Limestone.

The larger pits seen at Dwlban Point are about 6 feet in diameter at the top, and can be traced to a depth of about 5–6 feet. But about 230 yards to the south, at an inland crag across the débris of some ancient quarries, is a section showing a pipe no less than 12 feet in depth. (Fig. 3.) The rock pierced by the pipe is a very

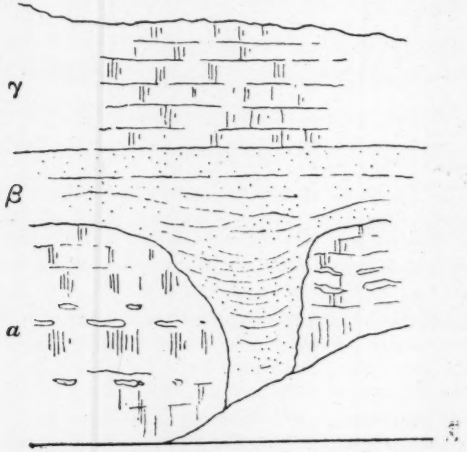


Fig. 3.—Large Pipe in Inland Cliff.
α, Cherty Limestone; β, Sandstone; γ, Upper Limestone.

massive grey, crystalline Limestone, with lines of chert nodules, and the material of the pipe is in connection with that of the base of a sandstone whose normal thickness is about 8 feet. Overlying this is another Limestone about 10 feet thick, rather fine and dark, and poor in fossils. Except at the pipe the sandstone lies in perfect conformity with both Limestones. It is a white, hard rock, mostly fine, but with some lines of pebbles. The funnel-shaped pipe, whose

bottom is not seen, gives rise to a shallow cave, and in this it appears to widen out somewhat behind the face of the crag, as though it were there more basin-shaped than where cut by the plane of section. The bedding of the sandstone in the pipe is somewhat irregular, and bends gently downwards near the mouth.

The material of the plugs is a fine white, hard sandstone, weathering light brown. It weathers also very cavernously, as though calcareous, though a specimen examined at home did not effervesce with acid. There are a few small lenticular nests of little pebbles, but no pebbles were observed more than 1 inch in diameter. The weathered plugs show marked bedding, which is parallel to that of the series as a whole. There seem also a concentric structure and concentric colour banding. The jointing tends to be radial.

In both cases the Limestones penetrated by the pipes are thoroughly marine, as shown by the fossils, though at Dwlban Point the upper parts become somewhat sandy. No unconformity can be observed between the beds, but just below the base of the sandstone at the coast the Limestone becomes full of cracks, which widen upwards into small fissures filled in with sand and pebbles.

Whatever their origin, the pipes appear to be contemporaneous with the series as a whole. There is no sign of collapse in the beds above them, for the gentle downward bend in the great pipe affects only the material within the pipe itself, and not the overlying beds; indeed, the tendency is to a heaping into domes above them. They are suggestive of potholes, but there is no really coarse material in them, pebbles, though present, being both rare and small. The smaller plugs seem to be the more pebbly.

The suggestion has been made that the beds overlying the piped Limestone represent fresh-water episodes and upheaval, with accompanying denudation.[1] Shales and sandstones in similar positions in the Penmon area do, indeed, contain abundant plant-remains, though no pipes were observed by me there. But at Dwlban Point the shale above the sandstone (γ, Fig. 2) has yielded a shell which, though very poorly preserved, Mr. E. T. Newton, F.R.S., who was so good as to look at it for me, believes to be *Spirifera ovalis*, while the sandstone itself contains what seem to be annelid castings. Mr. J. Bennie, formerly of the Geological Survey of Scotland, has also very kindly examined the shale for minute organisms, but has hitherto failed to find any. The whole series therefore appears to be marine. The fissuring of the upper surface of the Limestone, however, points to an interval of exposure after hardening; and it is interesting also to note that the Penmon Sandstones above alluded to contain pebbles of Carboniferous Limestone (Q.J.G.S., 1896, pp. 628, 629). We may conclude, then, that the piping took place during an interval of shallowing, and, perhaps, exposure of the sea-bottom. This was probably quite local, for the sandstones in this region are for the most part of very limited extent.

[1] By Mr. P. F. Kendall, F.G.S., during the discussion at the meeting of the British Association.

It is curious that these pipes should occur in the same area at three different horizons, the great pipe being somewhat above those of the Dwlban Point, while some seen to the north of Benllech must be much lower in the series.

V.—On Deflected Glacial Striæ at Dwlban Point, East Anglesey.

By Edward Greenly, F.G.S.

THE Limestone of the foreshore at Dwlban Point is magnificently glaciated, the ice-worn surfaces being preserved for a distance of some yards from the Boulder-clay. The striæ where undeflected run N.N.E.–S.S.W., which is in agreement with the general direction of the glaciation on that part of the coast.

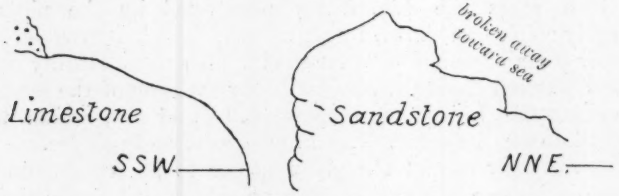


Fig. 1.—Profile of Glaciated Pit.

The rock is not merely striated, but furrowed, and in one furrow a ledge of rock facing N.N.W. is undercut so as to overhang some 3 or 4 inches, the slope of the overhanging surface being as much

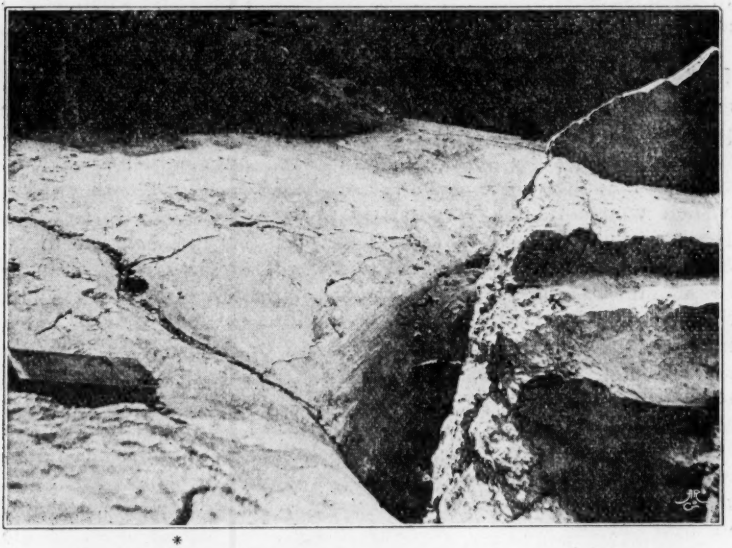


Fig. 2.—Deflected Glacial Striæ, Dwlban Point, Anglesey.

The normal direction of striation is that of a line joining the small round hole on the left with the small fissure at *. Boulder-clay is seen in the background; and, on the right, part of a Sandstone plug in its pit.

as 15°–30° from the vertical. This undercut furrow is distinctly smoothed and striated.

The trumpet-shaped mouths of the pits described in the foregoing paper are beautifully ice-worn, though the heads of their sandstone plugs are for the most part rough and angular.

The striæ are deflected on passing across the mouths of the pits. In the case of one pit, about 6 feet in diameter, whose profile with its plug is shown in Fig. 1, the striæ sweep completely round in the moat-like hollow surrounding the plug, until on its S.S.W. side they are pointing more than 20° N. of W. These deflected striæ are shown, for part of their course, in the photograph[1] (Fig. 2). On the broad and gently convex surface of Limestone just outside the hollow they have the normal direction S. 25°–30° W., so that the deflection in the space of some 2 yards is nearly 90°.

The agent which produced this phenomenon and that of the undercut furrows must have adapted itself, it would seem, as a practically plastic body, to every irregularity in the surface of the rock.

A Red Clay, somewhat poor in stones, rests upon the ice-worn surface, forming a cliff about 12 feet high.

VI.—Note on a Boring through the Chalk and Gault near Dieppe.[2]

By A. J. Jukes-Browne, B.A., F.G.S.

THE following particulars of a boring for water made at Puys, near Dieppe, in 1898 have been communicated to me by Messrs. Legrand and Sutcliff, and as they appear to indicate a succession of beds very similar to that occurring beneath Dover, the present seems a fitting occasion for placing on record a brief account of the boring.

Puys is a small village less than a mile and a half north-east of the entrance of Dieppe Harbour, and the site of the boring is at an hotel by the sea-shore, the well-mouth being not more than 50 yards from high-water mark and about 45 feet above mean sea-level.

The beds passed through by the boring are described as follows, the thicknesses being given in metres and in feet:—

	Metres.	Feet.
Chalk without flints	156	511½
Greensand and sandy clay	2	6½
Gault clay	42	137¾
Black sand and pyrites, passing down into clean quartzose sand	11½	37¾
	211½	693½

[1] For this photograph and that illustrating the preceding paper, as well as for the lantern slides and other photographs of these phenomena, used at the British Association, I am indebted to Mr. J. Trevor Owen, M.A., Headmaster of the County School, Carnarvon.

[2] An abstract of only the first part of this paper was read before the British Association at Dover, September, 1899.

According to the diagrammatic section of the coast-line given by Hébert in 1872, Puys stands on the chalk of the *Holaster planus* zone,[1] which corresponds to the lowest part of the flinty chalk east of Dover. Thus the chalk traversed by the boring is the equivalent of the whole of our Lower and Middle Chalk. In 1875 Hébert estimated the thickness of the *planus* zone near Dieppe at 11 metres (36 feet) and that of his zone of *Inoceramus labiatus* (our zones of *Rhynchonella Cuvieri* and *Terebratulina gracilis*) at 70 metres (230 feet). The three zones taken together, therefore, are estimated at 266 feet, and if we deduct this from the 511½ feet of chalk traversed by the boring, there remains 245½ feet as the thickness of the Lower Chalk. This is rather a greater thickness than might have been expected for the Lower stage, and it is probable that the Middle Chalk or Turonian is rather thicker than Hébert supposed. As a matter of fact he measured 65 metres of it in the cliff itself, and its base is nowhere exposed; hence it is not at all unlikely that its full thickness is nearly 75 metres (or 247⅓ feet), and in this case the thickness assignable to the Lower Chalk will be 228 feet, which is a more probable amount.

The two metres of greensand and sandy clay at the base of the Chalk probably corresponds with what we know as the Chloritic Marl or zone of *Stauronema Carteri*. This has a thickness of about 15 feet at Folkestone, but not more than 4 feet near Eastbourne.

As nothing of the nature of sandstone or 'gaize' is recorded in the boring, we may assume that nothing of an 'Upper Greensand' character is present below Dieppe, and that the zone of *Ammonites rostratus* is represented by clay and marl as it is at Wissant and Folkestone. This is interesting as showing that what may be called the Folkestone facies of Gault extends as far as Dieppe, which is about 78 miles south of Folkestone and rather less from Wissant.

November 10.—Since the above was written I have received, through the kindness of Monsieur G. Dollfus, a more complete account of this boring. The following is a translation :—

		Thickness. Metres.	Depth. Metres.
	Ground excavated	2·75 ...	2·75
Gault. Cenomanian & Turonian.	White marl	59·25 ...	62·00
	Soft white marl	4·25 ...	66·25
	Grey marl	·45 ...	66·70
	White marl	3·30 ...	70·00
	Grey marl with flints	4·00 ...	74·00
	Hard white marl	14·30 ...	88·30
	Hard marl (with *Inoceramus labiatus*)	22·70 ...	111·00
	Grey chalk	20·25 ...	131·25
	Grey chalk with flints	6·25 ...	137·50
	Grey chalk	8·50 ...	146·00
	Greenish sandy clay	10·20 ...	156·20
	Green sandy clay	2·10 ...	158·30
	Black clay	41·20 ...	199·50
	Clayey green sand	6·80 ...	206·30
	Grey sand	3·15 ...	209·45
	Black sandy clay	2·05 ...	211·50

[1] Bull. Soc. Géol. France, ser. II, vol. xxix, p. 586.

The only specimen seen by Mons. Dollfus was one of a hard chalk with fragments of *Inoceramus labiatus*; this he is inclined to refer to the Turonian, but as the species also occurs in the highest part of our Lower Chalk, I am disposed to think the base of the Middle Chalk was traversed at 88·30 metres, i.e. 289½ feet. He agrees with me in regarding the "green sandy clay" as the base of the Cenomanian, which thus has a thickness of 229½ feet.

The only important difference between the account furnished to me and that communicated to Mons. Dollfus is in regard to the lowest beds, for it seems that the boring passed through the grey sand at 209·45 metres and entered a black sandy clay. It is impossible to suppose the Vectian sands to be only 10 feet thick below Dieppe, nor is it likely that a thick bed of black sandy clay should occur in them; consequently M. Dollfus believes that both the sand and the clay belong to the Gault.

In support of this view he sends the particulars of another boring recently made at the Château d'Eu in the valley of the Bresle, about 16 miles north-east of Dieppe. Samples and fossils from this boring were seen and determined by M. Munier-Chalmas, and there is consequently a much greater certainty about the horizons. The following is a translation :—

		Thickness. Metres.	Depth. Metres.
	Alluvia of the valley of the Bresle	10·89	10·89
Turonian.	White chalk with *Rhync. Cuvieri*	8·61	19·50
	Firm white chalk with some flints	11·90	31·40
	Chalk without flints, some hard lumps	16·70	48·10
	Chalk without flints, very sticky	2·40	50·50
	Grey chalk	·83	51·33
	Soft yellow chalk	1·67	53·00
	Grey and white chalk, in hard and softer beds alternating, *Inoc. labiatus*	17·46	70·46
Cenomanian.	Grey and blue argillaceous chalk, with *Belemnites*	3·12	73·58
	Soft white chalk, with *Holaster*	8·62	82·20
	Grey compact chalk	3·42	85·62
	Marly grey chalk	22·38	108·00
	Greenish-grey sandy chalk	16·18	124·18
	Green clayey glauconitic chalk	14·82	139·00
Upper Gault.	Black clay with *Inoceramus*	11·75	150·75
	Greenish quartzose sand	6·75	157·00
	Black and green sandy clay	1·50	159·00
	Pure green sand	1·60	160·60
	Green and black clay, with *Ammonites auritus* and *Am. splendens*	2·60	163·20
	Greenish-grey sand and sandstone	2·90	166·10
	Bed of greenish sandstone	·16	166·26
	Green sand with large grains of quartz	1·54	167·80
	Black sandy clay	1·10	168·90
	Green quartzose sand (not pierced)	—	171·80

This boring is very interesting in several ways. In the first place the base of the Turonian is clearly fixed at 70·46 m., and the base of the Cenomanian at 139 m. This gives a thickness of 68·54 m. (= 224·8 feet) for the Cenomanian or Lower Chalk, thus corroborating my interpretation of the Dieppe boring. In the next place the curious alternations of black clay and green sand, which

evidently belong to the Upper Gault (zone of *Ammonites rostratus*), are very noteworthy.

Lastly, it is remarkable that these sands in the Gault should yield an abundant supply of water. In the case of the Dieppe boring the water rose to about 12 feet above the surface, and at Eu it rose to 50 feet above the surface with a yield of 750,000 litres in the 24 hours.

The beds traversed by the two borings may be summarized thus:—

	Dieppe.		Château d'Eu.
	Feet.		Feet.
Surface deposits	9 ?	...	35·7
Middle Chalk	280·3	...	195·4
Lower Chalk, with Chloritic Marl at the base	229·6	...	224·8
Gault (not pierced)	174·5	...	107·5
	693·4		563·4

NOTICES OF MEMOIRS.

Diprotodon australis. Fossil Remains of Lake Callabonna. Part I: Description of the Manus and Pes of *Diprotodon australis*. By E. C. Stirling, C.M.G., F.R.S., etc., and A. H. C. Zietz, F.L.S.

THIS lavishly illustrated memoir contains the first instalment of the description of the remarkable series of skeletons of *Diprotodon* discovered some years ago in the dried-up bed of Lake Callabonna in South Australia. A brief account of the discovery was published in *Nature* (vol. L, 1894, pp. 184 and 206) by Professor Stirling, and a description of the remarkable bird-remains from the same locality has also appeared.

The present memoir deals with the structure of the fore and hind feet, which are almost the only important parts of the skeleton not described by Owen. The collections included a considerable number of more or less complete feet, so that the authors have been able not only to describe in great detail the separate bones, but also to give restorations of the manus and pes, both of which exhibit some remarkable characters.

The fore-foot possesses five complete digits, of which the fifth is the largest; the fifth metacarpal has a broad flange-like expansion on its outer side. The pisiform bears more than half the articular surface for the ulna.

The hind-foot also possesses five digits, but the first consists of the metatarsal only. The second and third digits are extremely slender, the fourth only a little stouter, but the fifth is very much thicker, the metatarsal bearing a great flange-like expansion. The whole foot is a most remarkable structure, but, although considerably modified on account of the great weight it had to bear, it still retains distinct marsupial characters.

The general conclusions arrived at by the authors are as follows:—

"Marsupial characters are evident in both the manus and pes of *Diprotodon*.

"So far as the individual constituent bones are concerned they present resemblances to their homologous parts in both the Phalangeridæ and the Phascolomyidæ, but the approximation to the former is, on the whole, greater than to the latter.

"On the other hand, regarding the feet as a whole, they, in their shape and proportions as well as in the character and degree of the attenuation of the second and third digits of the pes, are more readily comparable to these members in the Phascolomyidæ.

"With the more specialized pes of the Macropodidæ, comparison of that of *Diprotodon* yields scarcely any points of resemblance, except in so far as the character of the degradation of the hind-feet, similar in kind but varying in degree, affords evidence of the marsupial nature of both."

The memoir is excellently illustrated by a series of eighteen very good photographic plates, including two of the restored manus and pes.

REVIEWS.

I.—Fossil Radiolaria. By Dr. G. J. Hinde, F.R.S., F.G.S.

1. "Note on some Radiolarian Chert from the South Uplands of Scotland": Quart. Journ. Geol. Soc., vol. xlvi (1890), Proc., p. 111, and Ann. Mag. Nat. Hist., ser. vi, vol. vi (1890), p. 40.
2. "Note on the Radiolaria in the Mullion Island Chert." By G. J. Hinde, Ph.D., V.P.G.S. Quart. Journ. Geol. Soc., vol. xlix (1893), pp. 215–218, pl. iv.
3. "Note on a Radiolarian Rock from Fanny Bay, Port Darwin, Australia." By George Jennings Hinde, Ph.D., V.P.G.S. 8vo; pp. 221–226, pl. iv. Quart. Journ. Geol. Soc., vol. xlix (1893).
4. "On a well-marked Horizon of Radiolarian Rocks in the Lower Culm-measures of Devon, Cornwall, and West Somerset." By G. J. Hinde, Ph.D., F.R.S., F.G.S., and Howard Fox, Esq., F.G.S. 8vo; pp. 609–667, pls. xxiii–xxviii. Quart. Journ. Geol. Soc., vol. li (1895). Supplementary Note, etc., Trans. Devon Assoc., vol. xxviii (1896), pp. 774–789.
5. "On the Radiolaria in the Devonian Rocks of New South Wales." By G. J. Hinde, Ph.D., F.R.S., F.G.S. 8vo; pp. 38–63, pls. viii and ix. Quart. Journ. Geol. Soc., vol. lv (1899).
6. "On Radiolaria in Chert from Chypon's Farm, Mullion Parish, Cornwall." By George Jennings Hinde, Ph.D., F.R.S., F.G.S. 8vo; pp. 214–219, pl. xvi. Quart. Journ. Geol. Soc., vol. lv (1899).
7. "Description of Fossil Radiolaria from the Rocks of Central Borneo." By Dr. George J. Hinde. 4to; 36 pp., with 4 plates. (E. J. Brill, Leyden; and H. Gerlings, Amsterdam: 1899.)

AMONG the various minute aquatic organisms that have persistent structure within or without their bodies, several kinds have been recognized by naturalists, with more or less exact discrimination, since natural history became a definite study, after the dark ages of

mediæval ignorance had cleared away. Thus the relatively large 'water-fleas' of streams and ditches, and the sand-like 'ammonites' of the Adriatic, were objects of curiosity for some, and the Diatomaceæ, mistaken for Infusoria, were before long carefully studied, from both fresh and salt waters. So also the spicules of Sponges were noticed, classified, and figured. Together with some of the foregoing, in either a recent or fossil state, other minute organisms, of great beauty in their delicacy and symmetry, had been met with, but their real place in nature was not determined until within fifty years ago. These, when alive in the sea, have a jelly-like body, invested or supported by a complex but delicate and often elegant framework of meshes and spicules, mostly siliceous. Johannes Müller, of Berlin, indicated their true alliance by grouping them as "Rhizopoda Radiaria seu Radiolaria," in 1858.

These attractive little organisms were known to exist in the Mediterranean and other seas, and to be fossil in thick strata at Barbadoes and elsewhere. During the Voyage of the "Challenger" in 1873–6, they were found to constitute a large percentage of the ooze over extensive oceanic areas. After long study of these organisms, Dr. E. Haeckel, determining their essential characters and modifications, classified them, with descriptions and illustrations, in his "Die Radiolarien," 1862, and the "Report of the Scientific Results of the Voyage of the 'Challenger' during the years 1873–76": Zoology, vol. xviii, 3 parts (1887).

The nuclear or medullary body, with its enclosing membrane or open-worked shell, either central or at one end of the axis, is enveloped with a protecting (cortical) sarcode, which extrudes pseudopodia, and in many cases is strengthened and invested by spicules, meshes, and radial spines, usually of silex, and of manifold form and arrangement. The persistent forms are usually regarded as belonging to the '*Polycistina*' of Ehrenberg and Müller. (*Polycistina* = many baskets; *Polycystina* = many bladders; used sometimes indifferently.)

In the case of those that have no shell, and those in which the radial spines are not composed of hard silica, there is little or nothing left in the fossil state. Otherwise numerous individuals remain more or less perfect in various rocks of the Palæozoic, Mesozoic, and Cænozoic formations. They mostly present "either simple or concentric latticed shells, some with relatively long radial spines; and they are similar in character to recent Radiolaria, and probably referable to the same genera as the latter."

However much modified in the individuals of different groups, yet the inner or nuclear capsule and the outer capsular investment (calymma) may be, their essential character is always recognizable. The spicules in the naked forms of the Spumellaria, and the hard parts of the other groups, constitute subsidiary evidences of the generic and specific differentiation.

In these, as in other low forms of life, Nature is so lavish of her productive power in the multiplicity and almost endless variations of growth, that at first sight it seems to be impossible to find the clue to the apparent entanglement of structural peculiarities in the

investments and their bizarre outgrowths. The clue, however, as noted above, is afforded by the innermost organ.

This is itself lost to the geologist, but its latticed capsule, and the radial spines which partly form the transverse bars and beams of the whole organism, may have remained, more or less imbedded in limestones, shales, and sandstones, probably altered into marbles, schists, and quartzites. Indeed, many fine-grained siliceous rocks now appear to have resulted from Radiolarian ooze itself.

In comparing the fossil and the recent specimens, the student has to recollect that the general form is either globular, ellipsoidal, or like vases, caps, umbrellas, discs, irregular stars, chambered cones, etc., all perforate, fenestrate, or reticulate, with the meshes lengthening out into spines on the surface or at the edges. The radial rod-like spines, whether or not beginning in the middle of the nuclear lobe, are often united by branching spicules at or near the surface of the calymma, and similarly become involved in the outer lattice-shell.

In the Spumellaria the skeleton, if present, consists of either pure silica or of a peculiar silicate (silicate of carbon?); the rods are solid, as in the Nassellaria, and do not begin in the centre. In the Acantharia the rods begin in the centre, and consist of acanthin. In the Nassellaria the skeleton is siliceous; the rods are solid, usually monaxial, and belong to the outer capsule (calymma). In the Phæodaria the skeleton consists of a silicate, and belongs to the outer capsule.

Radiolaria from strata of Tertiary age have been examined by many observers. Some are figured by Ehrenberg, who gave neatly executed drawings, but did not otherwise advance our scientific knowledge of these microzoa. In his "Mikrogeologie," 1854, some Radiolaria appear (as 'Polycystina') from Tertiary beds at Ægina, Zante, and Caltanisetta, Sicily. These are noted, as to their geological age, in the Ann. Mag. Nat. Hist., ser. IV, vol. IX (1872), pp. 223, 225, and 228.

Messrs. Jukes-Browne & Harrison, treating of the siliceous rocks of Barbados (Quart. Journ. Geol. Soc., vol. li, 1892, pp. 193–4), refer to Haeckel's statement that many of the Barbadian Radiolaria are not known in the modern oceanic ooze, and that about 25 per cent. of those fossil forms are present in the ooze. These results are taken as determining a Pliocene age for the West-Indian siliceous strata referred to.

Cretaceous Radiolaria have been freely studied: for instance, by Rüst, 1888; Zittel, 1888; Pernet, 1891; Fritsch, 1893; Hill & Jukes-Browne, 1895; and Cayeux, 1897. They have not, however, been fully classified and strictly compared with other faunæ.

Jurassic Radiolaria are known chiefly from Dr. Rüst"s Memoir in the "Palæontographica," vol. xxxi (1885).

M. Lucien Cayeux[1] has compiled a table of the geological occurrence of Radiolaria of Mesozoic and earlier date, in which he refers

[1] "Contribution à l'étude micrographique des Terrains sédimentaires, etc." (4to, Lille, 1887), p. 206. The Cretaceous Radiolaria of France and Belgium are dealt with at pp. 185–206 and 450–452, pls. vii and viii.

Spumellaria	Sphæroidea to the Pre-Cambrian, Silurian, Devonian, and Senonian. Prunoidea to the Silurian, Devonian, Carboniferous, Permian?, and Senonian. Discoidea to the Silurian, Devonian, Permian, and Jurassic.
Nassellaria	Cyrtoidea to the Pre-Cambrian, Devonian, Carboniferous, and Senonian.

These results differ somewhat from those given in this notice of Dr. Hinde's Radiolarian researches.

Dr. G. J. Hinde, whose important memoirs descriptive of Radiolarian rocks from different parts of the world are enumerated at the head of this article, noticed in 1890 some chert beds, composed mainly of Radiolaria, from the South Uplands of Scotland (in Lanarkshire and Peebleshire), belonging to an Ordovician formation equivalent to the Llandeilo-Caradoc series of Wales, and in which the late Dr. H. A. Nicholson had already observed these microzoa.

In 1893 Dr. Hinde determined two genera of the Order Sphæroidea, and three of Prunoidea, in the chert of Mullion Island off the Lizard Peninsula, Cornwall, and suggested that they may be of the same age as the Ordovician cherts of Scotland.

In the same year, examining a siliceous rock from Fanny Bay, Port Darwin, Northern Australia, he found one genus of Prunoidea, five genera of Discoidea, and three of Cyrtoidea.

In 1895 Dr. Hinde found in the cherts of the Lower Culm-measures of Cornwall, Devon, and West Somerset, one genus of Beloidea, eight genera of Sphæroidea, three of Prunoidea, seven of Discoidea, and four of Cyrtoidea. Of these twenty-three genera, "twenty-one have been previously determined from the Palæozoic formations of this country and the continent"; and of these, seventeen have been determined by Dr. Rüst from the Culm of Germany, Sicily, and Russia.

In the same year Dr. Hinde examined some Radiolarian rocks of Devonian age from New South Wales, namely, siliceous claystones and shales, volcanic tuff, and chert from Tamworth, also jaspery cherts with few and badly preserved Radiolaria from Bingera, Barraba, and Jenola Caves. Although some associated Corals indicate a Devonian age, the Tamworth Radiolaria correspond on the whole with those from the Ordovician (Lower Silurian) phosphorites and siliceous shale of Cabrières and Languedoc, described by Rüst ("Palæontographica," vol. xxxviii, 1892), and those of the South Uplands of Scotland, of corresponding age (Hinde, p. 60). The apparent absence of Cyrtoidea distinguishes this from Mesozoic and Tertiary faunæ; the predominating forms being Sphæroidea, with medullary tests and radial spines. The Cyrtoidea were either not represented or by a small minority in the earlier deposits.

The Tamworth Radiolaria are:—

	Genera.	Species.
Beloidea	1	1
Sphæroidea	14	28
Prunoidea	4	7
Discoidea	8	12
Plectoidea	2	6
	29	54

The Ordovician chert of Chypon's Farm, in Mullion parish, continuous with the Radiolarian chert of Mullion Island, was examined in 1899, and yielded: Sphæroidea, 3 genera (with 3 species); Prunoidea, 3 genera (6 species); and Discoidea, 1 genus (1 species).

Dr. Hinde's latest memoir on Radiolaria has been prepared as an Appendix for the "Geology of Central Borneo," to be published by Professor Dr. G. A. F. Molengraaf, of the Dutch Exploring Expedition, in 1893–4. In his Introduction Dr. Hinde describes the outcrops and general character of the Radiolarian rocks under notice, namely, jaspers, cherts, hornstone, and diabase tuff. Their local occurrence in the siliceous rocks and in the tuffs, and the distribution of these fossil Radiolaria in other countries, are indicated in the table at pp. 44–46, and treated in detail in the text:—

	Genera.	Species.
Beloidea	1	1
Sphæroidea	5	17
Prunoidea	5	12
Discoidea	6	16
Cyrtoidea	13	54
	30	100

These rocks are stated to underlie strata of Cenomanian age, and they seem to belong either to the latest Jurassic or the earliest Cretaceous age, as is the case also with the Radiolarian cherts and jaspers of the Coast Range in California.

Great services have been rendered to geology by Dr. Hinde's elucidation of the relics of some very obscure Invertebrata, in his successful studies of the Silurian Conodonts, of Sponges of every group and age, and now of Palæozoic and other Radiolaria. He has thus indicated how the relative age of many rocks may be determined by the evidence of several kinds of microscopic fossils.

II.—*Helicoprion*—Spine or Tooth?

"Ueber die Reste von Edestiden und die neue Gattung *Helicoprion*." By A. Karpinsky. Verhandl. k. russ. min. Ges. St. Petersburg, ser. II, vol. xxxvi, No. 2, with 4 pls. and 72 text-figs. (1899).

PALÆONTOLOGISTS are indebted to the eminent Director of the Imperial Russian Geological Survey for one of the most exhaustive memoirs on a fossil ever published. Dr. Karpinsky's description of the strange 'ichthyodorulite,' *Helicoprion*, is a model of what such a work should be—thorough from every point of view, geological, chemical, and biological. It is, moreover, illustrated by exquisite plates, besides numerous text-figures, representing not only the outward form of the problematical fossils dealt with, but also every feature of their microscopical structure.

Helicoprion, to a superficial observer, looks much like an ammonite; but on closer inspection it is easily recognizable as a spiral consisting of teeth firmly fixed together by their bases. Fragments of a more or less similar spiral have already been

described under the name of *Edestus* from Carboniferous strata in North America, Russia, and Western Australia; but no specimens at all approaching the two best of the fossils now made known by Dr. Karpinsky have hitherto been discovered. The rival theories by which *Edestus* has been sometimes ascribed to the jaws, sometimes to the external dermal armour of a shark or skate, can thus be discussed again in the light of important new facts. If the Edestidæ must still remain as Elasmobranchs of uncertain zoological position, the memoir before us at least makes great accessions to our knowledge of the essential points in the structure of their so-called segmented spine.

The new fossils forming the subject of the memoir were discovered by Mr. A. Bessonow in the Permo-Carboniferous (Artinsk Series), near Krasnoufimsk, in the Government of Perm. They comprise two nearly complete spirals from 0·238 m. to 0·260 m. in diameter, besides three fragments, and were sent by their discoverer to the Museum of the Imperial Geological Survey, St. Petersburg. The ends of both spirals are incomplete, but both exhibit approximately $3\frac{1}{2}$ whorls, all in one plane and apparently bilaterally symmetrical. The segments or teeth of the central whorls are relatively very small, but they rapidly increase in size towards the periphery, and are largest at the free outer end. In one specimen 136, in the other specimen 146 segments are preserved or indicated. The segments resemble those of the typical species of *Edestus* in all respects, except that the enamel extends far down the middle of the side of the base, and there is a notch at the inner extremity of the base. These two features, together with the remarkable extent of the spiral, are rightly judged by Dr. Karpinsky to be the marks of a distinct genus, which he names *Helicoprion*. All the new specimens are placed in a single species, named *H. Bessonowi* after their discoverer. *Edestus Davisi*, H. Woodw., from the Carboniferous of Western Australia, is provisionally referred to the same new genus.

After a detailed description of the general characters of these remarkable fossils, Dr. Karpinsky illustrates their microscopical structure by a series of beautifully prepared sections. They are shown to consist of vaso-dentine, without any trace of bone-cells; and the superficial enamel seems to be the ordinary gano-dentine or vitro-dentine.

Chemical analyses by Mr. B. Karpow are also discussed, and the conclusion is arrived at that the fossil itself consists chiefly of a substance closely resembling apatite.

Two or three of the specimens exhibit numerous small granules over and around the bases of the segments. These are next treated in great detail, and the description is again illustrated by beautiful microscopical preparations, of which figures are given. Dr. Karpinsky regards these granules as shagreen or placoid scales, though he finally admits that he does not know shagreen granules of precisely the same structure in any other Elasmobranchs. In our opinion they are not dermal structures, but the well-known

granular calcifications of Elasmobranch cartilage,[1] which are often mistaken for shagreen by palæontologists.

Having described the new fossils and determined their generic and specific characters, Dr. Karpinsky concludes with a most exhaustive discussion of their true nature, which is facilitated by the concise sketch of our previous knowledge of *Edestus*, given as an introduction to the memoir. He regards four results as established: (i) that *Helicoprion* belongs to an Elasmobranch; (ii) that the bases of all the segments of the spiral were embedded in the soft parts of the fish; (iii) that the spiral must have been situated in the vertical median plane of the fish; and (iv) that the whole of the spiral, except the large end, must have been exposed. In a diagrammatic sketch he represents the problematical fossil as originating in the upper jaw, and curling forwards and upwards so that the spiral forms a terrible weapon above the snout. On this supposition, each individual would possess only a single weapon of the kind.

In connection with the last-mentioned circumstance, it would be interesting to know whether the five examples of *Helicoprion* discovered in the quarry near Krasnoufimsk were found close together at one time, or whether there is any other evidence of their natural association. For a recent discovery by Dr. Traquair in the Lower Old Red Sandstone of Turin Hill, Forfarshire,[2] proves undoubtedly that there were Palæozoic sharks with sharp, piercing teeth, which were never shed, but became fused into whorls as the animal grew. If he be correct, the teeth in these Lower Devonian sharks even formed spirals; for he considers that the so-called *Onychodus anglicus* from Ledbury, figured in the Brit. Mus. Catal. Foss. Fishes (pt. ii, pl. xv, fig. 1), truly belongs to the same Elasmobranch genus as the head from Forfarshire. It is well-known that the crushing dental plates in the Elasmobranch Cochliodontidæ sometimes became considerably in-rolled at the outer margin where they could not break away.[3] The discovery of Elasmobranchs with cutting or piercing teeth similarly disposed is therefore not surprising. The fact that the known specimens of *Edestus* and *Helicoprion* are bilaterally symmetrical does not necessarily relegate them to the median line, if they happen to be whorls of teeth; for several of the anterior rows of teeth in the living *Chlamydoselache* exhibit essential bilateral symmetry.[4] Moreover, it may be remarked that the possibility of *Edestus* and *Helicoprion* being whorls of teeth from the mouth is not negatived by the absence of lateral facettes or marks of contact with adjoining whorls: they may have been well separated, as in the existing shark just mentioned. The conception

[1] Compare figures by Williamson, Phil. Trans., 1851, pl. xxx, fig. 29; and A. Fritsch, "Fauna der Gaskohle," vol. ii (1889), p. 101, figs. 178, 180.

[2] R. H. Traquair, "Notes on Palæozoic Fishes": Ann. Mag. Nat. Hist. [7], vol. ii (1898), p. 69 (*Protodus scoticus*, E. T. Newton, sp.).

[3] E.g. *Cochliodus contortus*, Ag.: J. W. Davis, Trans. Roy. Dublin Soc. [2], vol. i (1883), pl. lii, figs. 4*a*, 5.

[4] S. Garman: Bull. Mus. Comp. Zool. Harvard Univ., vol. xii, No. 1, p. 6, pl. ii.

of a gigantic shark armed in both jaws with several series of teeth like those now described under the name of *Helicoprion* is, indeed, sufficiently startling; but it seems to us more likely to be realized than the hypothesis which Dr. Karpinsky's most interesting researches have led him to propose. A. S. W.

III.—Fauna der Gaskohle und der Kalksteine der Permformation Böhems, von Dr. Ant. Fritsch, F.R.G.S. Bd. iv, Heft 1, Myriopoda, Pars 1; and Bd. iv, Heft 2, Myriopoda, Pars 2, Arachnoidea. 4to; pp. 1–32 and 33–64, pls. cxxxiii–cxliv and cxlv–cliii. (Prague, 1899.)

THE progress of this important work, dealing with the fauna of the Gas-coal of Bohemia, has been noticed from time to time in the Geological Magazine. In the fourth volume the author commences the description of the Articulata of the Permian formation. There is little to say concerning the Hexapoda, or Insects proper; three species of *Phryganea* are recorded as evidenced by the cases of the larvæ of the Caddis-fly, and some fragments of the wings of the adult insect. Of Orthoptera (Cockroaches) he describes *Etoblattina Bohemica*, *Arthroblattina Lubnensis*, and two others, chiefly from wings, and three insects of uncertain determination.

Pages 13 to 55 of the two parts are occupied with descriptions and figures of the wonderful series of Myriopoda, of which no fewer than thirty-four species are enumerated, some being smooth unspined forms like the modern *Julus*, others armed with rows of powerful curved and branched spines (each compound or double division of the body bearing two pairs of legs), well-developed tracheæ, a head furnished with compound and simple eyes (ocelli), and one pair of antennæ.

Such forms of centipedes have long been known from the Carboniferous Series, both in England and America. The earliest record of the discovery of terrestrial Arthropods from the Coal-measures of England was made by the late Rev. P. B. Brodie in 1845, in his "History of Fossil Insects." In this work Professor Westwood states that he regarded the organism (which we now know to be part of a gigantic spined Myriopod) as the remains "of some large Caterpillar furnished with rows of tubercles." The late J. W. Salter in 1863 described a similar fossil from the Clay-ironstone of the Staffordshire Coalfield under the name of *Eurypterus* (*Arthropleura*) *ferox*, and referred to it, as a most curious crustacean fragment, part of the spined abdomen of a *Eurypterus*. Messrs. Meek & Worthen, in their Geological Survey of Illinois (1868), were the first who correctly recognized these fossils from America as the remains of gigantic spined Myriopods. Similar forms have since been described by Scudder in America and Dr. Woodward in England (see Geological Magazine, 1887).

Numerous illustrations are given in the text to show the character and arrangement of the rows of branched spines upon the sides of the dorsal surface of the segments, the trachæal openings, the jointed

legs, the form of the head, the compound eyes, the ocelli, the antennæ, and the jaws. Nineteen plates are likewise devoted to the illustration of the various forms of these curious Myriopods, giving full detail of their structure and ornamentation. One form of King-crab is also described under the name of *Prolimulus Woodwardi* (Fritsch). The shales in which these remains abound are pyritous, and the fossils in them very rapidly perish. In order, therefore, to rescue the evidence of these organisms from destruction, the author has hit upon the idea of making electrotypes of all the important specimens, which thus become permanent records in the Prague Museum. This is no novel process, however, as Jules Marcou introduced the same method of electrotyping the Trilobites of Canada forty years ago.

One cannot fail to be impressed by the great antiquity of these curious forms of many-jointed terrestrial air-breathers, which even at this early geological period enjoyed so wide a geographical distribution over the globe. Their primitive character and simple elongated forms, with sometimes cylindrical, sometimes flattened body, present the greatest resemblance to the Annelids in the serial similarity of the rings of the body and in their mode of locomotion.

The genera described by Dr. Fritsch embrace *Acantherpestes*, 3 species; *Euphoberia*, 2 species; *Isojulus*, 3 species; *Pleurojulus*, 6 species; *Anthracojulus*, 1 species; *Pylojulus* (*Xylobius*), 4 species; *Acroglomeris*, 2 species; *Archiscudderia*, 5 species; *Glomeropsis*, 4 species; *Hemiphoberia*, 1 species; *Purkynia*, 1 species; *Heterovorhoefia*, 1 species; and *Sandtneria*, 1 species.

The Arachnoidea also appear to claim a very early place among the air-breathers in geological time. No scorpions are here figured by Dr. Fritsch, although some of the earliest examples of this remarkable type were obtained by Count Sternberg from Bohemia. The spiders are represented by the genera *Hemiphrynus*, 2 species; *Promygale*, 3 species; *Arthrolycosa*, 3 species; and *Pyritaranea*, 1 species. On plate cliii is figured a remarkable example of *Arthrolycosa prolifera*, a female having a cocoon of well-developed young attached to its body. Enlarged figures of some of the embryo spiders are given. One is at a loss to understand how the small shells known as *Spiroglyphus vorax* happen to be found attached to the body of a spider (*Promygale rotundata*, pl. cliii, fig. 4); these small discoidal spiral shells were formerly considered as the cases of marine, or at least aquatic, Annelids. They were probably forms of some kind of parasitic tube-dweller, perhaps terrestrial.

We cannot help expressing regret that the draughtsman who prepared the plates had not possessed a more delicate and artistic perception of the objects he has delineated. They might have been made so much more beautiful by being less coarse and heavy in execution, and the expenditure in colouring seems to us to be after all of doubtful value compared with extreme accuracy of minute detail and correct drawing of the outlines.

All praise is due to Dr. Fritsch for the earnest labour he has bestowed for so many years in bringing out his great work on the

fauna of the Gas-coal of Bohemia. It has cost the author much money, which we fear he will never be recouped; but students of palæontology all over the world cannot fail to be grateful to him for making them acquainted, by means of this work, with the rich and varied fauna of the Permo-Carboniferous Series of Bohemia.

IV.—The International Geography. By Seventy Authors. Edited by Hugh Robert Mill, D.Sc., F.R.S.E., etc. 8vo; pp. xx and 1,090, with 488 Illustrations. (London: George Newnes, Limited, 1899. Price 15*s.*)

IF any evidence were wanting in order to prove the vast and ever-increasing importance which a knowledge of geography has of late years assumed, we have but to turn to the enormous development which the closing years of the century has witnessed in the issue of maps, both geological and topographical, and the cheapening of their production so as to bring them within the reach of all who seek for such knowledge as they convey.

Along with maps of all kinds, come naturally in importance handy books of reference bearing upon all questions of geography which maps portray graphically, but do not explain so fully as can be done in a textbook. Dr. Hugh Robert Mill, from the vantage-ground of his position as an officer of the Royal Geographical Society of London, has been enabled, with the aid of a whole army corps of authors, to bring together in a little over 1,100 well and clearly printed pages, a complete summary of the globe, arranged under countries, giving in each case an account of its general configuration and geology, its river-systems, climate, natural resources, and a brief notice of its fauna and flora. The several peoples are described as to race, language, history, and mode of government; with their manufactures and external trade; and especially the main industries peculiar to each country; with their system of internal communications. The political divisions are considered individually, together with notices of towns. All towns with populations of 100,000 and upward are separately noticed, and all other towns which are of special importance. In every case where it is possible, the characteristics of the site which determines the position of a town, or the geographical conditions which minister to its prosperity, have been noticed. A statistical table, giving the area and population at the last two censuses of the whole country, and in federal countries of the constituted states; the average values of exports and imports for three five-yearly periods, ten years apart, e.g., for 1871–75, 1881–85, 1891–95, have been taken, and the chief towns with their population at the two last censuses.

The introductory general discussions of mathematical, physical, commercial, and political geography are written from a strictly *geographical* point of view, and in a purely *general* manner, referring only to such phenomena or conditions as are not restricted to particular regions. The object has been, not to give a treatise on the subject named, but to supply the few general facts and

principles necessary to the comprehension of the special geography of each individual country. The general description of each continent refers only to the largest and most determinative features, and these are taken in the following order: coasts, surface, geology, climate, flora, fauna, anthropology, history, including territorial changes of the largest order.

To afford some further insight into the arrangement of the work we may mention that the principles and progress of geography are treated by Dr. H. R. Mill; mathematical geography, dealing with the form and dimensions of the earth, and the methods employed for determining and representing the positions of places upon its surface, a chapter full of most valuable and concise information, is by Dr. A. M. W. Downing, F.R.S.; maps and map-reading, by the veteran cartographer, E. G. Ravenstein; the plan of the earth, dealing with its form, is by Dr. J. W. Gregory, F.G.S., of the British Museum,[1] and treats of "the tetrahedral theory of the earth," which we need not now discuss here, but refer our readers to this work and to Gregory's original paper (Geographical Journal, 1889, vol. xiii, p. 225).

The next chapter on "Land-Forms," by Dr. Hugh Robert Mill, treats of the relative divisions of the earth's crust into oceanic plateau, continental slope, continental plateau, and culminating area; of land-forms, of the materials of the earth's crust, giving the nature of the geological formations, their order of succession, and the subsequent forms and features produced by crustal movements, subaerial and marine denudation, and the result of rivers. Sir John Murray and Dr. Mill follow with a chapter on the oceans, which is concise and up to date. In this, as in other parts of the work, in consequence of the earnest effort made to condense the greatest amount of information into the smallest possible space, the 488 text-illustrations suffer in consequence, both in size and quality, and some of them hardly do justice to the work. This will, we hope, be recognized, and remedied in a second edition, which is certain to be called for. Mr. H. N. Dickson follows with a chapter on "The Atmosphere and Climate"; and Professor J. Arthur Thomson, on "The Distribution of Living Creatures," in which the author discusses that most interesting question, the relation of the dry-land and fresh-water faunas to the littoral fauna, the pelagic, the deep-water, and the abyssal faunas, and suggests that a *littoral* fauna was probably the original one whence have been derived on the one hand the pelagic and abyssal faunas, and on the other those of the fresh waters and dry land. Professor Brooks, on the contrary, maintains that the pelagic fauna was primitive, for there the conditions of life are easiest; while Sir John Murray takes the fauna of the 'mud-line,' i.e. the boundary between the abyssal and the littoral (or neritic) regions at an average depth of about 100 fathoms, as the primitive life-zone. Here the minute organic and inorganic particles derived from the land and surface-

[1] Just appointed (as we write) to the Chair of Professor of Geology in the University of Melbourne, Victoria, Australia.

waters find a resting-place upon the bottom, the great feeding-ground of the ocean, and which seems to be very densely peopled. He holds to the view "that in early geological times there was a nearly uniform high temperature over the whole surface of the globe, and a nearly uniformly distributed fauna and flora; and that with the gradual cooling at the Poles, species with pelagic larvæ were killed out or forced to migrate towards the Tropics, while the great majority of the species which were able to survive in the Polar areas were those inhabiting the mud-line" (p. 95).

"The Peoples of the Earth and the Distribution of Mankind," which forms the subject of a chapter by A. H. Keane, deals with the human race from a geological as well as a zoological standpoint. Of course, the Pliocene man from Java, *Pithecanthropus erectus* (spelt in error '*erectis*'), takes a prominent place, but we have always felt that Dr. E. Dubois's discovery rested upon extremely slender evidence, and that too large a superstructure of theory should not be built upon so small a foundation of fact. After treating of the various races of mankind, the writer remarks that from Neolithic times the Ethiopic and American groups have been losing, whilst the Caucasians and Mongols have been everywhere gaining ground, with results expressed in terms of population as under:—

Caucasians	770,000,000
Mongols	540,000,000
Ethiopians	175,000,000
Americans	22,000,000
Total	1,507,000,000

We can only hope that in the struggle of races the Caucasian may maintain his superiority over the Mongol, but time alone will show whether he will be able to do so or not.

Part I ends with a chapter on Political and Applied Geology, by Dr. J. S. Keltie, Secretary of the Royal Geographical Society, carrying us to p. 121, which may be considered to conclude the introductory matter of the volume.

Part II contains the sum and substance of the work itself. Commencing with the geography of Europe, pp. 123–421, Asia follows next, pp. 422–574, taking in Japan and the East Indian Islands. The next section deals with Australia and Polynesia, pp. 575–663. North America commences book 4, pp. 664–781. Central and South America occupy book 5, pp. 782–888. Africa forms book 6, pp. 889–1024. The last section of the book treats of the Arctic and Antarctic regions (pp. 1025–1053), a chapter full of interest both for geologists and geographers.

As a proof of the value of this book as a handy work of reference, it may be mentioned that the index contains about 15,400 names of places described and localized in the body of the work, besides references to temperatures, winds, climate, population, animals, plants, geology, minerals, rivers, mountains, fisheries, timber, and endless other matters that may well be included in such a comprehensive work.

We are much indebted to the editor and his vast array of authors for this valuable volume, which is certain to find a place in every scientific library, and in every series of books of ready reference in both private and public libraries in England, America, and our Colonies.

REPORTS AND PROCEEDINGS.

Geological Society of London.

I.—November 22, 1899.—W. Whitaker, B.A., F.R.S., President, in the Chair.

The President, having requested all present to rise from their seats, expressed in feeling terms the sorrow felt by the Society at the unexpectedly sudden loss of an esteemed Fellow and genial friend, Dr. Henry Hicks, F.R.S., V.P.G.S., to whose energy and perseverance the Quarterly Journal owed so many papers, and from whom many more valuable contributions might have been expected in the years to come. The following resolution had been passed by the Council that afternoon, and a copy thereof had been communicated to Mrs. Hicks with an expression of sincere sympathy:—

> "That the Council desire to place on record their great grief at the loss which Geological Science and the Geological Society have sustained by the death of their Vice-President, Dr. Henry Hicks, who so recently occupied the Presidential chair, and so energetically attended to the welfare of the Society."

The President then said that the Society had to deplore another severe loss in the person of their revered friend, Sir J. William Dawson, C.M.G., F.R.S., who died at Montreal on Sunday, the 19th inst. The Council had passed the following resolution:—

> "That the Council have heard with deep regret of the decease of the old and valued Fellow of the Geological Society, Sir J. W. Dawson, who for nearly fifty years has taken an active part in advancing geological knowledge in general, and more especially with regard to the great Dominion of Canada; and they desire to assure Lady Dawson, and the distinguished Fellow of the Society, Dr. George Dawson, of the Council's sincere sympathy in their loss."

The following communications were read:—

1. "On some Remarkable Calcisponges from the Eocene Tertiary Strata of Victoria (Australia)." By George Jennings Hinde, Ph.D., F.R.S., F.G.S.

The greater number of the sponges described were discovered by Mr. T. S. Hall, M.A., of Melbourne University, in incoherent detrital beds of Eocene age, in the southern part of Victoria; a few were picked out of some washings of fragmental polyzoa from the same district and horizon, by Mr. B. W. Priest. Some of the specimens are in an extremely perfect condition, and their structural details are as distinctly shown as in recent sponges. They are also of more than local interest in that they are the first fossil forms described of a group of calcisponges, the Lithonina, characterized by the peculiar aberrant forms of some of the spicules, and the mode in which they are closely fitted and organically fused together to form the skeletal mesh. This structure has, so far, only been recognized in one recent species, *Petrostroma Schulzei*, Döderlein, from the Japanese Sea.

The sponges are small, unattached, with a glassy, firm, resistant skeleton, calling to mind that of siliceous Lithistida. They are built up of a great variety of spicular forms; some are simple rods, with three- and four-rayed spicules, similar to those in recent calcisponges; but the majority are aberrant four-rayed forms, with three of the rays curved and with obtuse or expanded ends which are clasped, and fused as well, to the surfaces of adjacent spicules. The connected spicules form continuous anastomosing or radial fibres resembling those in the fossil Pharetrones, to which they are in some other respects similar, and it is probable that the spicules in the fibres of some members of this family were likewise organically cemented together. The common *Porosphæræ* from the Upper Chalk, generally regarded as Hydrocorallines allied to the recent *Millepora*, are also closely related to the above sponges, and the author hopes shortly to publish the evidence for their affinity to this group.

The Victorian sponges are placed in four new species, belonging to three genera: two of these are new; the other, *Bactronella*, Hinde, was founded on some peculiar calcisponges of Jurassic age, now known to be Lithonine in character.

2. "The Silurian Sequence of Rhayader." By Herbert Lapworth, Esq., F.G.S.

This paper opens with a general reference to the Ordovician and Silurian complex of Central Wales, and a notice of the geological work hitherto done in the region. The stratigraphical relations of the Silurian formations which occur in the country surrounding the town of Rhayader (Radnorshire) are then described in detail. Typical and confirmatory sections are given, demonstrating the complete local sequence of the rocks of the Rhayader district. These are illustrated by lists of characteristic graptolites. These fossils are compared with those of Southern Scotland, Sweden, and North Wales, showing that the graptolite succession is everywhere similar, and fixing the age of the Rhayader Series as representing the Lower Llandovery, Upper Llandovery, and Tarannon of other areas. Finally, several new species of *Climacograptus* and *Diplograptus* are described.

The author establishes the following sequence :—

Rhayader Group (Pale Shales).				= Gala and Tarannon Group.
Caban Group.	Gafallt Beds.	Gafallt Shales.		= Upper Llandovery, May Hill, and Upper Birkhill.
		M. Sedgwicki-grits.		
	Caban Conglomerates.	Upper Conglomerate.		
		Intermediate Shales.		
		Lower Conglomerate.		
Gwastaden Group.	Gigrin Mudstones.	Pale Grey Mudstones.		= Lower Llandovery and Lower Birkhill.
		Zone of *M. convolutus*.		
		Calcareous Nodule-beds.		
	Ddôl Shales.	Zone of *M. fimbriatus*.		
		,, *M. cyphus*.		
		,, *M. tenuis*.		
	Dyffryn Flags.	*D. modestus*-flags.		
		Rottenstone Beds.		
		Micaceous Flags & Grits.		
	Cerig Gwynion Grits.			
	Blue-black Shales.			= Bala and Hartfell.

No single section, taken in any direction across the Rhayader country, shows the complete succession. In any area some one group is always better developed than others; and some portion of at least one group is certain to be missing. The lowest, or Gwastaden Group, has a maximum thickness of over 1,800 feet. It is underlain, apparently conformably, by highly cleaved dark-blue shales, and overlain unconformably by both the Caban and Rhayader Groups. The base of the Gwastaden Group is formed of a thick mass of grauwackes, which thin to the east and thicken to the west. They contain *Climacograptus*, and pass up into mixed flags and grits with *Climacograptus* and *Diplograptus*. These are succeeded by shales and mudstones in which the first Monograptidæ appear. These become dominant in the upper part.

The succeeding Caban Group has a maximum thickness of 1,500 feet. Its lower division consists of two massive conglomerates, separated by shales; its higher division is made up of fine-grained grits, shales, and flags. Each member of the group is overlapped to the east by the next subgroup above it, until eventually the whole group disappears beneath the Rhayader Pale Shales, which in the eastern areas rest directly on the Gwastaden rocks.

The Rhayader Group consists of pale-green, blue, and grey shales and mudstones, which overstep on to the Gwastaden beds; and may possibly pass completely over them, and rest on the dark shales farther east.

After the Gwastaden rocks were laid down, the sea-floor appears to have been elevated and denuded, a hollow being scoured out to the eastward. Rapid sinking followed, and the sea filled the hollow with the Caban sediments, practically levelling it up by the time that the deposition of the Pale Slates began.

Tables of fossils enable the author to establish a complete comparison of the whole of the local zones of the Rhayader district with those of Southern Scotland, Wales, and Sweden. In the Rhayader area we find, for the first time in Britain, the entire Valentian succession developed in one general sequence of rocks, with a more or less common lithological character, and with a fauna composed throughout of similar palæontological types.

II.—December 6, 1899.—W. Whitaker, B.A., F.R.S., President, in the Chair.

Dr. Blanford said that he had been asked by Professor Judd, who was unable to attend, to say a few words about certain photographs sent by Mr. E. H. L. Schwarz, and representing the Dwyka boulder-bed and the rounded and grooved underlying surface, in the neighbourhood of the Orange River near Hopetown and Prieska. The importance of these photographs lay in the evidence which they afforded on a disputed point. Dr. Sutherland and Mr. Griesbach had called attention to the evidence of ice-action presented by the Dwyka Conglomerate in Natal, and additional evidence had been brought forward by several observers, especially by Mr. Dunn from the Orange Free State and Cape Colony, and recently by Dr. Molengraaff from the Transvaal. Other observers, however, and especially the late Professor Green, had disputed the glacial origin of the Dwyka beds. The photographs now exhibited would, the speaker thought, convince most geologists that the phenomena presented were due to ice-action. The resemblance to similar photographs shown to the Society in 1896 by Professor T. W. Edgeworth David, and representing the beds corresponding to the Dwyka Conglomerate in South Australia, was noteworthy. Evidence of glacial action in Upper Palæozoic times had gradually accumulated from India, Australia, and South Africa, and there was a probability that similar indications existed in South America.

The following communications were read:—

1. "On the Geology and Fossil Corals and Echinids of Somaliland." By Dr. J. W. Gregory, F.G.S.

British Somaliland consists of a high plateau, of which the northern scarp is separated from the Gulf of Aden by a belt of low hills and plains known as the Guban. The southern plateau consists of Archæan gneisses, quartzites, amphibolite-schists, chloritic schists, and pegmatites. It is capped by purple grits, red sandstones, and conglomerates, which are covered by limestones of Neocomian, Turonian (? Cenomanian), and Eocene ages. The Neocomian limestone, which may be correlated with that of Singeli described by Rochebrune, occurs at Dobar in the Guban; while a Jurassic limestone, probably of Bathonian date, occurs at Bihendula in the Guban. Fossils collected from these limestones and from raised reefs of Pleistocene age, by Mr. and Mrs. Lort Phillips, Miss Gillet, Mr. G. P. V. Aylmer, Captain E. T. Marshall,

and Mr. F. B. Parkinson, have been examined by the author, who tabulates a list of corals and echinids. One new genus and fourteen new species of corals are described, belonging to the genera *Stylophora, Stylina, Columnastræa, Prionastræa, Favia, Metethmos, Cyclolites,* and *Litharæa,* and one new species of *Pseudodiadema.* The evidence of the collections is sufficient to show that a Neocomian limestone occurs both on the summit of the Somali plateau and on the floor of the Guban, and that some marine limestones of Lower Tertiary age (probably Eocene) also occur on the plateau. It is therefore evident that the foundering of the Aden Gulf is post-Eocene in age.

2. "Note on Drift-gravels at West Wickham (Kent)." By George Clinch, Esq., F.G.S.

The author describes two beds of Drift-gravel at West Wickham. The first, occupying the bottom of a dry valley, yields, in a section exposed at Gates Green, material derived from the Chalk and the Lower Greensand; and distinct, although perhaps not direct, relation with the denudation of the Weald is claimed for it. The other bed of gravel is of later age, and has yielded many Palæolithic implements and flakes. The specimens of these exhibited were found by the author between 1880 and 1885, and they establish the existence of Drift-gravels about a mile south of Hayes Common. Some of the implements have lost their pointed ends and bear other indications of use, many are smoothed and rounded by Drift-wear, but a few are entirely unworn, while some, particularly the larger examples, are bruised and crushed by such influences as the ploughshare and waggon-wheels. Most of the implements have a superficial colouring, varying from a pale straw-tint to a rich ochreous-brown. "The association of much-worn implements, unworn implements, and flakes, cores, and waste-chips, in the same bed of Drift-gravel points to the fact that we have here a collection of material which was brought from a great variety of places, and has undergone a great variety of conditions and changes."

3. "On the Occurrence in British Carboniferous Rocks of the Devonian Genus *Palæoneilo,* with a Description of a New Species." By Dr. Wheelton Hind, B.S., F.R.C.S., F.G.S.

The family Nuculidæ is represented in Carboniferous rocks by the genera *Nucula, Nuculana,* and *Ctenodonta,* and to these must now be added *Palæoneilo,* which the author describes from two fine specimens in the Museum of Practical Geology, from Carboniferous Shale (Yoredale Shale) south of Hammerton Hall, Slaidburn, Yorkshire. It is remarkable that a genus so well developed in Devonian times should be found at the top of the Carboniferous Limestone Series, but not in intermediate beds. Hall's diagnosis of the genus is given, with additional remarks, and a new species is described and contrasted with *Ctenodonta* (*Palæoneilo*) *lirata,* Phil., from the Devonian of Baggy.

CORRESPONDENCE.

THE GENERA *APATOKEPHALUS* (BRÖGGER) AND *TRAMORIA* (REED).

Sir,—With reference to the fauna of the Waterford Ordovician beds, it will be of interest to the readers of the Geological Magazine to learn that Professor Brögger informs me that the trilobite which I have recently described (Q.J.G.S., vol. lv, 1899, p. 758, pl. xlix, figs. 14–16) as *Tramoria punctata*, gen. et sp. nov., belongs without any doubt to the genus *Apatokephalus*, which was established by him in 1896 ("Ueber die Verbreitung der Euloma-Niobe Fauna [der Ceratopygenkalkfauna] in Europa," *Nyt Magazin fur Naturvidenskaberne*, Bd. xxxv, 1896, pp. 179–185, 200) for a group of species related to *Dikellokephalus* occurring in the widely distributed Euloma-Niobe fauna. In this country this fauna is contained by the Shineton Shales and the Tremadoc of North Wales. The form named by Salter *Conocoryphe invita* belongs to this new genus *Apatokephalus*, and the following species from Europe and America are also mentioned by Brögger as occurring in beds with this Euloma-Niobe fauna:—*Apatokephalus serratus*, Boeck; *A. angusticauda*, Ang.; *A. finalis*, Walcott; *A. Schlotheimi*, Billings; *A. magnificus*, Billings. We have now to add *Apatokephalus punctatus* to the above list, and the generic name *Tramoria* must be dropped.

Professor Brögger adds that this identification lends important support to my view that the fauna of the Waterford beds has a facies resembling that of the homotaxial Scandinavian beds, especially of the Asaphus Stage (Ét. 3, Brögger). The occurrence of genera characteristic of the Euloma-Niobe fauna in beds of a higher stratigraphical horizon in Wales, and their association with a later fauna of a different character in shallow-water deposits, are facts also noticed by Brögger in the paper referred to. With regard to the wide geographical distribution of this fauna and the presence of its most characteristic genera of trilobites in distant areas, Brögger shows that it extended from 65° N. lat. to 43° N. lat., and is represented not only in Sweden but at Hof in Bavaria, St. Chinian in Languedoc, Shropshire, North Wales, and America, wherever the bionomical conditions were favourable. No barrier, therefore, between the Baltic and British provinces can have existed at this time, and it is shown that the supposed distinct characters of the trilobitic faunas are based upon an erroneous separation of genera and species owing to a want of acquaintance with foreign specimens.

F. R. Cowper Reed.
Woodwardian Museum, Cambridge.
November 29, 1899.

THE GEOLOGICAL SURVEY OF EGYPT.

Sir,—Since the commencement of this Survey in October, 1896, the officers attached have carried out a geological and topographical reconnaissance over a large portion of the country, besides a certain amount of more detailed work in some areas. During this time many new facts have been brought to light, in numerous cases

necessitating entirely different conclusions to those arrived at by earlier observers in the same field.

Unfortunately, up to the present, the Egyptian Government has not been able to publish any maps or descriptions of the regions surveyed, and even if, as proposed, publication is undertaken in the coming year, a considerable time must necessarily elapse before the accumulated results of three years can be brought out.

In an abstract report in the *Zeitschrift für praktische Geologie* for November, 1899, of a paper entitled "Neues zur Geologie und Paläontologie Aegyptens," by Dr. Max Blanckenhorn, the following statement occurs:—"Den von v. Zittel beschriebenen Cenomanvorkommen reihen sich zwei neue im eigentlichen Aegypten gelegene und von Blanckenhorn gefundene an. Das erste liegt im O. des Nils am Gebel Chebrewet; das zweite, westlich des Nils gelegene, ist das der Oase Baharia mitten im Eocänplateau der Libyschen Wüste. Das letztere weist auch in Limonit umgewandeltes Holz (*Palmoxylon*) und gut erhaltene Abdrücke von Dicotyledonenblättern in demselben Versteinerungsmittel auf, ein vielversprechender Aufschluss über die Kreideflora Aegyptens."[1]

As the copy of this abstract report was sent to this Survey by Dr. Blanckenhorn himself, I am forced to conclude that he claims to have himself discovered the existence of rocks of Cenomanian age in Baharia Oasis, which as far as I know he has never visited, and can only have derived his geological information from an examination of my own specimens.

In view of this, it is advisable to put on record some of the more important conclusions at which I have arrived. They are briefly as follows:—In 1897 the discovery of the existence of extensive faults along the west margin of the Nile Valley, and the absence of high fluviatile deposits, pointed to the conclusion that the Nile gorge is not a "valley of erosion," but probably a line of rift and faulting. In 1899 similar faults were again found along the east side between Assiut and Kena.

A thick and extensive series of limestones, tufas, clays, sandstones, and pebble-beds has been shown to occur throughout the Nile Valley, from Esna to the Fayoum on the west side and from Kena to Minia on the east, during work carried on between 1896 and 1899. Although they are generally of fresh-water origin, Mr. Barron and I, by the discovery of marine foraminifera in these beds near Luxor in January, 1897, showed that marine conditions existed far up the Nile Valley in comparatively recent times, these beds being probably of Pliocene age. In 1897 an extensive series of fossiliferous Cretaceous beds of Cenomanian to Danian age was discovered and mapped in Baharia Oasis, and the junction of the Cretaceous and

[1] To the occurrences of Cenomanian rocks described by Zittel are added two new ones, situated in Egypt proper. The first lies on the east of the Nile at Gebel Chebrewet; the second, situated on the west of the Nile, is that of the Oasis of Baharia in the midst of the Eocene plateau of the Libyan Desert. The latter also shows wood (*Palmoxylon*) converted into limonite, and well-preserved impressions of Dicotyledonous leaves in the same matrix. This exposure promises to afford valuable information as to the Chalk-flora of Egypt.

Eocene in this area was found to be marked by a strong unconformity and overlap. This had never been previously recognized in Egypt. In 1898 the existence of thick bone-beds, probably of considerable commercial value, was discovered in the Oasis of Dakhla. Again, in 1897, in the Abu Roasch district, near the Pyramids of Giza, the junction of the Cretaceous and Eocene was again found to be unconformable, instead of being marked by lines of fault, as formerly supposed. In the Western desert, and in one case in the Eastern desert also, igneous intrusions have been discovered at isolated spots in the sedimentary areas.

This brief statement of a few of my own results is rendered still more necessary in view of the fact that there are at the present time several observers about to visit the same regions. The details connected with these questions will probably be dealt with in the Survey Memoirs.

HUGH J. L. BEADNELL.

CAIRO, *7th December*, 1899.

ORGANIC REMAINS FROM CAMBRIAN ROCKS OF BRAY.

SIR,—The question of the age of the ancient beds of Bray and Howth has recently attracted some attention in connection with the additions to our knowledge of Cambrian and Pre-Cambrian rocks in other places. The true nature of the real or supposed fossils in these Irish beds is therefore an urgent one. *Oldhamia* has been obliged to submit to a verdict of Not proven, at the best. It is naturally asked whether *Histioderma* is to meet with a similar fate. Unfortunately, inquiries from various workers elicited the fact that the type-specimen was missing from the Irish Survey Collection.

Recently, however, in rearranging the mineral collection of the Royal College of Science for Ireland, we were fortunate enough to find four specimens of *Histioderma*, with their original tablet; these have now been restored to the Survey Collection, and will be exhibited in the Museum of Science and Art, Dublin. Two of the specimens are the internal and external casts of the same object, the former being the actual specimen figured as *Histioderma Hibernicum* by Dr. J. R. Kinahan in his paper "On the Organic Relations of the Cambrian Rocks of Bray and Howth; with Notices of the most remarkable Fossils": Journ. Geol. Soc. Dublin, vol. viii (1858), pp. 68–72, pl. vi, fig. 2.

A moment's examination of the actual specimens is enough to remove all doubt of the organic nature of *Histioderma*. It consists of a cup-shaped expansion, with two sets of approximately parallel ridges which intersect each other obliquely, and a conical root-like continuation below. Without denying the possibility of the correctness of Kinahan's explanation that the ridges represent the tentacles of an annelid, we cannot help thinking that the general appearance rather suggests that they are lines of thickening in a continuous muscular envelope.

GRENVILLE A. J. COLE.
JOHN W. EVANS.

ROYAL COLLEGE OF SCIENCE FOR IRELAND.
December 16, 1899.